PRACTICEBOOK OF GENERAL GEOGRAPHY

For Civil Services Prelims Examination

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PRACTICEBOOK OF GENERAL GEOGRAPHY

For Civil Services Prelims Examination

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Changes in this Edition:

1. Fully updated as per the latest pattern and trend of questions being asked in recent years of UPSC CSE.
2. Facts and Figures have been updated as per the latest information available.

Happy Learning and Happy Testing!!!

Your team @ForumIAS

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GENERAL GEOGRAPHY

UNIVERSE & THE EVOLUTION OF THE EARTH

1.1. Universe & the Evolution of Earth

1. Consider the following events:

1. The sun appears to rise in the East and sets in the West.
2. The mast of an approaching ship is seen before the hull.
3. The shape of the Moon appears to be changing each night.
4. Occurrence of different seasons on the Earth.

How many of the above events conclusively indicate that the Earth is spherical in shape?

(a) Only one
(b) Only two
(c) Only three
(d) All four

2. During the Summer Solstice in the Northern Hemisphere, which one of the following cities is likely to experience the longest duration of daylight?

(a) Thiruvananthapuram
(b) Hyderabad
(c) Pune
(d) Jaipur

3. The Earth will experience an equinox, i.e., equal lengths of daytime and nighttime, throughout the year under which of the following situations?

(a) If the Earth stops rotating on its own axis.
(b) If the Earth stops revolving around the Sun.
(c) If the Earth starts revolving around the Sun at a much faster speed.
(d) If the Earth starts rotating on an axis perpendicular to its orbital plane.

4. With reference to the length of twilight on Earth, consider the following statements:

Statement I: Places at higher latitudes would experience longer twilights as compared to those at lower latitudes.

Statement II: The Earth rotates faster at the Equator than at the poles.

Which one of the following is correct in respect of the statements given above?

(a) Both statement -I and statement -II are correct and statement -II is the correct explanation for statement -I.
(b) Both statement -I and statement -II are correct and statement -II is not the correct explanation for statement -I.
(c) Statement -I is correct but statement -II is incorrect.
(d) Statement -I is incorrect but statement -II is correct.

5. A ship captain receives a BBC radio broadcast stating that Greenwich Mean Time (GMT) is 5:00 AM. The ship's local time is 10:30 AM. Based on this information, in which of the following water bodies is the ship most likely located?

(a) Bay of Bengal
(b) Red Sea
(c) Mediterranean Sea
(d) Atlantic Ocean

6. Consider the following small island nations:

1. Tuvalu
2. Venuatu
3. Kiribati
4. Tonga
5. Samoa

How many of the above small island nations lie west of the International Date Line?

(a) Only two
(b) Only three
(c) Only four
(d) All five

7. With reference to dark matter, consider the following statements:

Statement-I: It is difficult to identify dark matter.

Statement-II: It does not interact with the electromagnetic force.

Statement-III: It does not have mass.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-II and Statement-III are correct, and both of them explain Statement-I.
(b) Both Statement-II and Statement-III are correct, but only one of them explains Statement-I.

(c) Only one of the Statement-II and Statement-III is correct and that explains the Statement-I.
(d) Neither Statement-II nor Statement-III is correct.

8. With reference to planet Venus, consider the following statements:

Statement-I: Venus is the hottest planet in the solar system.

Statement-II: Venus is the closest planet to the Sun.

Statement-III: Venus does not have an atmosphere.

Select the answer using code given below:
(a) Both Statement-II and Statement-III are correct, and both of them explain Statement-I.
(b) Both Statement-II and Statement-III are correct, but only one of them explains Statement-I.
(c) Only one of the Statement-II and Statement-III is correct and that explains the Statement-I.
(d) Neither Statement-II nor Statement-III is correct.

9. The Earth's magnetic poles are not fixed and gradually shift over time. This shifting can have significant effects on various phenomena. In this context, consider the following:

1. Difficulty in navigation for migratory birds.
2. Increased errors in navigation systems.
3. Increase in the frequency of earthquakes.
4. Weakening of Earth's gravitational pull.

How many of the above are effects of the shifting of magnetic poles of the Earth?
(a) Only one
(b) Only two
(c) Only three
(d) All four

10. With reference to the Annular Solar Eclipse, consider the following statements:

1. It occurs when the Moon is at or near its apogee, which is the farthest point in its orbit from Earth.
2. The "Ring of Fire" phenomenon is generally observed during this eclipse.
3. It occurs more frequently than hybrid solar eclipses.

Which of the statements given above are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

11. In context of the Solar System, consider the following planets:

1. Mercury
2. Venus
3. Earth
4. Uranus
5. Saturn

How many of the above mentioned planets rotate on their axis in a clockwise direction?
(a) Only two
(b) Only three
(c) Only four
(d) All five

12. With reference to outer space, which of the following can be used to measure the time-dependent expansion rate of the universe for understanding the age and evolution of the universe?
(a) Planck's Constant
(b) Cosmological Constant
(c) Hubble Constant
(d) Stefan's constant

13. In the context of astronomical events, the term 'Planet Parade', recently seen in the news, refers to:
(a) A scenario where multiple planets become equidistant from the Sun at the same time.
(b) A phenomenon where several planets are visible in the night sky simultaneously.
(c) A situation where some planets shift their orbits due to gravitational interactions.
(d) A rare event where planets appear to form a symmetrical circular pattern in the sky.

14. Which of the following statements is most closely associated with 'Chandrasekhar Limit'?
(a) Minimum distance between two stars to form a Binary star system.
(b) Minimum mass needed for a protostar to initiate nuclear fusion.
(c) Maximum mass of a stable White dwarf star.
(d) Maximum temperature that the core of a star can attain.

15. With reference to a phenomenon called 'Zero Shadow Day', consider the following statements:

Statement I: In India, while Bengaluru experiences Zero Shadow Day, New Delhi does not.

Statement II: Zero Shadow Day occurs when the Sun shines directly overhead at a place between the tropics.

Which one of the following is correct in respect of the statements given above?

(a) Both statement -I and statement -II are correct and statement -II is the correct explanation for statement -I.
(b) Both statement -I and statement -II are correct and statement -II is not the correct explanation for statement -I.
(c) Statement -I is correct but statement -II is incorrect.
(d) Statement -I is incorrect but statement -II is correct.

16. In context to the evolution of the Universe, 'Hubble Tension' seeks to explain which of the following?

(a) reasons for the formation of the first atoms when electrons trapped in orbits around nuclei.
(b) differences in measurements of the rate of expansion of the Universe.
(c) generation of very high-energy cosmic rays by the Sun leading to removal of primordial gases
(d) division of black holes into three categories according to their masses

17. With reference to the Solar system, consider the following statements:

1. Mercury and Venus are the only planets which do not have any natural satellites.
2. Saturn is the only planet which has rings around it.
3. The asteroid belt between Mars and Jupiter is the only region which houses all the asteroids of the solar system.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 3 only
(d) None of the above

18. Consider the following statements:

Statement-I: During the equinoxes, both the Northern and Southern Hemispheres experience approximately equal duration of day and night.

Statement-II: During the equinox, neither the South nor the North Pole of the Earth is tilted towards the Sun.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

19. In the context of astrobiology, the term 'Goldilocks Zone' refer to a-

(a) region in space where the temperature is neither too hot nor too cold, making it potentially suitable for life.
(b) zone where the magnetic field of a planet is stable, protecting it from harmful cosmic radiation.
(c) belt of asteroids located between the orbits of Mars and Jupiter, potentially rich in resources for future explorations.
(d) boundary around a black hole, beyond which even light cannot escape.

20. Consider the following statements:

As we go from Equator towards Poles on Earth-

1. the distance between latitudes increases.
2. the distance between longitudes decreases.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

21. Which one of the following statements is correct with reference to the "Earth's Axial tilt"?

(a) Axial tilt has an impact on the length of day and night on Earth.
(b) It has no effect on the seasons on earth.
(c) Earth has the largest axial tilt in the solar system.
(d) Without axial tilt, the equator would have had lesser temperature than at the poles.

22. With reference to 'Circle of Illumination', consider the following statements:

1. It is a circle that divides the day from night on the Earth.
2. It is perfectly aligned with the axis of the Earth.
3. It always bisects the equator, resulting in equal day lengths in the equator.

Which of the above given statements is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 3 only
(d) 1 only

23. With reference to the consequences of halting of Earth's rotation, consider the following statements:

1. While some portions of the earth face continuous daylight, other parts experience complete darkness.
2. Immediate death of all photosynthetic organisms on the Earth.
3. Major changes in the global circulation of ocean currents.

Which of the above given statements is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 only
(d) 1 only

24. With reference to the International Date Line (IDL), consider the following statements:

1. It is an imaginary line located entirely along 180 degrees longitude.
2. International date line passes through the Bering strait.
3. A person crossing the IDL from west to east gains a day.

Which of the above given statements is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

25. Consider the following statements regarding Summer Solstice in the Northern Hemisphere (NH):

1. The onset of the summer solstice in the Northern hemisphere marks the beginning of 'Dakshinayan' in which the Sun appears to move southward in the Sky.
2. At the summer solstice in the Northern hemisphere, the North Pole of the Earth points more directly toward the Sun than at any other time during the year.
3. At the summer solstice in the northern hemisphere, sunlight is equally distributed across all regions within this hemisphere.

Which of the above given statements is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 3 only
(d) 2 only

26. Consider the following statements:

Statement - I: The gravitation force is greater at the poles and lesser at the equator.

Statement - II: The distance from the centre of the Earth is greater at the poles than at the equator.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

27. Consider the following statements with reference to the steady-state theory of origin of the universe:

Statement - I: It states that the universe is always expanding but maintains a constant average density.

Statement - II: It considers that matter is continuously created to form new stars and galaxies at the same rate that old ones become unobservable.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

28. Consider the following description:

1. These are small, solid objects that were formed during the early stages of the solar system's development.
2. They are regarded as the building blocks of planets and contributed to the formation of planetary bodies through accretion.

Which of the following is best described in the above given description?

(a) Accretion Discs
(b) Oort Cloud
(c) Planetoids
(d) Planetesimals

29. With reference to Jovian and Terrestrial Planets of the Solar System, consider the following statements:

1. All the planets outside of the asteroid belt are Jovian planets.
2. The terrestrial planets have zero confirmed moons, except for the Earth.
3. Jovian planets do not possess any atmosphere.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 3 only
(c) 2 only
(d) 2 and 3 only

30. With reference to planets in the Solar system, consider the following statements:

1. Earth has highest density among all the planets in the solar system
2. Uranus has the largest number of satellites among all the planets of the solar system.
3. Neptune is the third largest planet in the solar system.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3
(c) 1 and 2
(d) 1 and 3

31. The Earth's primordial atmosphere, composed mainly of Hydrogen and Helium, was lost primarily due to:

(a) Intense solar winds
(b) Degassing process
(c) Photosynthesis
(d) Collision with asteroids

32. In the context of objects in outer space, consider the following differences between Asteroids and Comets:

1. Comets are made of ice and dust while asteroids are made of rock.
2. Comets are found usually between the orbits of Jupiter and Mars, while asteroids are found mostly in the Kuiper Belt.
3. Unlike Asteroids, comets do not revolve around the Sun.

Which of the statements given above is/are correct?

(a) 1 and 3 only
(b) 1 only
(c) 3 only
(d) 1 and 2 only

33. With reference to the evolution of life on Earth, consider the following organisms:

1. Fishes
2. Reptiles
3. Blue Green Algae
4. Amphibians

What is the correct chronological sequence in which the above mentioned organisms first appeared on Earth?

(a) 1-3-4-2
(b) 3-2-4-1
(c) 3-1-2-4
(d) 3-1-4-2

34. Consider the following statements:

Statement I: Only one side of the Moon is visible from the Earth.

Statement I: The Earth has a slightly ellipsoidal shape.

Statement III: The Moon and the Earth are tidally locked.

Which one of the following is correct in respect of the statements given above?

(a) Both statement -II and statement -III are correct and both of them explain statement -I.
(b) Both statement -II and statement -III are correct, but only one of them explains statement -I.
(c) Only one of the statements II and III is correct, and that explains statement -I.
(d) Neither Statement -II nor statement -III is correct.

35. The Big Bang Theory suggests that the universe is constantly expanding. What does this expansion mean?

1. The distance between the galaxies is increasing.

2. The size of the stars and planets is gradually increasing.
3. The universe is becoming more opaque with time.

Select the correct answer using the code given below:
(a) 1 only
(b) 1 and 3 only
(c) 1, 2 and 3
(d) 2 only

36. The Nebular Hypothesis was one of the theories postulated to explain the evolution of celestial objects. It proposes that the:
1. solar system developed out of an interstellar cloud of dust and gas called a nebula.
2. planets were formed from a cloud of material containing mostly hydrogen and helium.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

37. The 'Big Splat theory' sometimes seen in news is related to which of the following ?
(a) The formation of the Earth's Moon.
(b) Study of Asteroids to unravel the mysteries of the Universe.
(c) The study of Solar Winds and its impact on the Earth.
(d) Study of Saturn's ring and search for the possibility of life outside Earth.

38. Consider the following phenomena:
1. Earth experiencing days and nights.
2. The sun is vertically above the equator for two days every year.
3. Change in lengths of day and night.
4. High temperature in summers and low temperature in winters.

How many of the above phenomena occur due to the revolution of Earth?
(a) Only one
(b) Only two
(c) Only three
(d) All four

39. With reference to the longitudes and latitudes of the Earth, consider the following statements:
1. All longitudes have equal length whereas length of latitudes varies depending upon their location.
2. Longitudes, along with latitudes, enable people to accurately pinpoint locations anywhere on the globe.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

40. Consider the following statements and select the correct answer using the code given below:

Assertion (A): To orbit around the Sun, the planet Mars takes more time than the time taken by the Earth.

Reason (R): The diameter of the planet Mars is less than that of Earth.

Code:
(a) Both (A) and (R) are individually true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are individually true but (R) is not the correct explanation of (A).
(c) (A) is true, but (R) is false.
(d) (A) is false, but (R) is true.

41. Consider the following phenomenon:
1. It will be difficult to hear any sound.
2. Birds and planes would fall from the sky.
3. The Earth will experience extreme temperatures.

How many of the above phenomena will occur if the atmosphere of the earth completely disappears suddenly?
(a) Only one
(b) Only two
(c) All three
(d) None

42. Consider the following statements regarding the phenomenon of 'blue moon':
1. It occurs when two full moons occur in a calendar month.
2. Generally, the phenomenon of blue moon occurs only once in every 15 to 20 years.

Which of the above given statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

43. Consider the following statements:

Statement I: A black hole is an astronomical entity that cannot be seen by telescope.

Statement II: The gravitational field on a black hole is so strong that it does not allow even light to escape.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect, but Statement-II is correct.

44. A person stood alone in a desert on a dark night and wanted to reach her home which was situated in the west direction from the point where she was standing. She had no instruments to find the direction, but she located the polestar. The most convenient way now to reach her home is to walk-

(a) facing the polestar.
(b) opposite to the polestar.
(c) keeping the polestar to her left.
(d) keeping the polestar to her right.

45. What does the term "planetesimals" refer to?

(a) Massive celestial bodies formed during the later stages of star formation.
(b) Large, irregular chunks of rock and ice that orbit in the Kuiper Belt beyond Neptune.
(c) Small, solid objects that collided and merged to form planets during planetary accretion.
(d) The remnants of ancient planetary collisions that are now found in the asteroid belt between Mars and Jupiter.

46. Consider the following factors:

1. Photosynthesis
2. Solar winds
3. Escape of Light Gases to Space
4. Phenomenon of degassing

How many of the factors given above have contributed to the formation of the atmosphere on earth?

(a) Only one
(b) Only two
(c) Only three
(d) All four

47. With reference to the planets in the solar system, consider the following statements:

1. The terrestrial planets rotate slower than the Jovian planets.
2. The solar wind has removed more amounts of gas and dust from the terrestrial planets than the Jovian planets.
3. The terrestrial planets have higher gravity as compared to the Jovian planets.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1,2 and 3

48. With respect to the origin of Moon, which of the following theories/hypothesis explains formation of moon?

1. As per George Darwin, the Moon formed when a dumb-bell-shaped body eventually broke into Earth and Moon.
2. As per the Big Splat theory, the material forming the Moon was separated from the depression occupied by the Pacific Ocean.
3. As per the Accretion hypothesis, the Earth and the Moon formed together as a double system originating from the primordial accretion disk.

Select the correct answer form the code given below:

(a) 1 only
(b) 2 only
(c) 1 and 3 only
(d) 2 and 3 only

49. With reference to the evolution of Earth, consider the following statements:

1. The primordial atmosphere consisted majorly of hydrogen and helium gases.
2. The process of degassing allowed addition of water vapour, nitrogen and carbon dioxide to the atmosphere.
3. The oxygen was added into the atmosphere through photosynthesis only after the life developed on land.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1,2 and 3

50. Which of the following is incorrect in regard to the interaction of meteoroids with the Earth's atmosphere?

(a) Meteorites burn in the mesosphere layer of the atmosphere.
(b) When a meteoroid survives a trip through the atmosphere and hits the ground, it's called a meteor.
(c) A meteor shower happens when a stream of dust particles traveling through atmosphere burns.
(d) The "shooting stars" is that part of the meteoroids that burns in the atmosphere.

51. With reference to the Earth's satellite moon, consider the following statements:

1. Only one side of the moon is visible from the earth because the moon takes exactly the same time to rotate around its axis as the time taken by it to revolve around the earth.
2. Due to moon's gravity, the rotation speed of Earth is decreasing.

Which of the statements given above are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

52. Consider the following statements:

Statement I: Pole star enables sailors to identify the north direction.

Statement II: Pole star is not visible from most locations south of the equator.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

53. With reference to Solar System, Consider the following statements:

1. Earth is the densest planet in the solar system.
2. Mars is often referred to as the 'Earth twin' due to its similar size and proximity to the Sun.
3. Venus is often called the 'Red Planet' due to its reddish appearance.

Which of the above given statements are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1,2 and 3
(d) 1 and 2 only

54. Which of the following countries experiences the phenomenon of 'Land of Midnight Sun' during the summer solstice?

(a) Norway
(b) Switzerland
(c) Spain
(d) Greece

55. With reference to Standard time and Time zones, consider the following statements:

1. Earth is divided into various time zones each differing the next by 15 degrees in longitude.
2. Indian Standard Time is ahead of Greenwich Mean Time by 5 hours and 30 minutes.
3. A country can have multiple time zones.

Which of the above given statements is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2, and 3

56. Consider the following statements with reference to comparison between Terrestrial Planets and Jovian Planets:

1. Terrestrial planets are comparatively smaller in size than Jovian Planets.
2. Terrestrial planets rotate much faster than the Jovian planets.
3. Terrestrial Planets have a much thicker atmosphere compared to Jovian planets.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) 1 and 2 only
(d) 1 and 3 only

57. Consider the following statements about the apparent movement of the Sun observed from the Earth:

1. The days on which the sun is directly overhead at the equator are known as equinoxes.
2. During the summer solstice in the Northern Hemisphere, the sun is directly overhead at the tropic of Capricorn around 21st of June of the year.

3. According to Hindu astrology, the Winter Solstice in the Norther Hemisphere marks the beginning of Tropical Uttarayana.

Which of the statements given above is/are correct?
(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 only
(d) 1 and 2 only

58. Which of the following is/ are the reason(s) behind the phenomenon of Twilight?
1. Tilt of Earth's axis
2. Revolution of Earth around the sun
3. Rotation of Earth about its axis
4. Spherical shape of Earth

Select the correct answer using the code given below:
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

59. What will be the impact on insolation distribution on Earth if it is not tilted at an angle on its axis?
(a) One half of the Earth would be too hot with continuous insolation, while other half would be frozen due to absence of insolation.
(b) All the places on different latitudes will receive the same amount of insolation.
(c) The hot places would become cold due to reduced insolation and vice versa.
(d) There would be no seasonal variations in temperatures of a place.

60. With reference to the planets of the Solar System, consider the following statements:
1. Mars does not experience any seasons.
2. Venus has a very hot and high-pressure atmosphere.

Which of the statements given above is/ are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

61. With reference to the evolution of earth, consider the following statements:
1. Earth's early atmosphere primarily consisted of hydrogen and helium.
2. Volcanoes released water vapour and ammonia into the atmosphere.
3. Photosynthesizing bacteria released oxygen into atmosphere around 2.7 billion years ago.
4. In the beginning, the earth almost entirely consisted of molten magma.

Which of the statements given above are correct?
(a) 1 and 4 only
(b) 2 and 3 only
(c) 1, 2 and 4 only
(d) 1, 2, 3 and 4

62. Consider the following statements:
1. The albedo of an object determines its visual brightness when viewed with reflected light.
2. The albedo of planet Mercury is much greater than the albedo of the Earth.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

63. With reference to characteristics of the Sun, consider the following statements:
1. It was formed due to collapse of nebula under its own gravity.
2. Its core generates energy by converting hydrogen into helium through nuclear fusion.
3. It emits steady stream of charged particles called solar winds.
4. Solar flares are large eruptions of electromagnetic radiation from the Sun.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 1 only
(c) 3 and 4 only
(d) 1, 2, 3 and 4

64. Which of the following statements correctly defines the term "Orion arm"?
(a) Ring of stars formed after the supernova explosion.
(b) Dense concentration of newly formed stars.
(c) Outer disc of the galaxy which emit relatively low energy.
(d) A minor arm of the Milky Way Galaxy containing solar system.

65. Which of the following is the reason for the bulging of the equator?
(a) Revolution of the earth
(b) Rotation of the Earth
(c) Tidal force
(d) Magnetic pull of the earth

66. Which one of the following cities is nearest to the equator?
(a) Colombo
(b) Jakarta
(c) Manil
(d) Singapore

67. With reference to Black Holes, consider the following statements:
1. It is formed when a massive star collapses.
2. They have such strong gravitational force that even light cannot escape it.
3. There is no black hole in our solar system.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

68. Consider the following statements:

Assertion(A): Theoretically, it is possible to reach the edge of Universe.

Reason(R): Dark flow of matter limits the boundary of Universe.

Select the correct answer using the code given below:
(a) Both A and R are true and R is the correct explanation for A
(b) Both A and R are true and R is not the correct explanation for A
(c) A is true and R is false
(d) Both A and R are false

69. Which one of the following sets of elements was primarily responsible for the origin of life on the Earth?
(a) Hydrogen, Oxygen, Sodium
(b) Carbon, Hydrogen, Nitrogen
(c) Oxygen, Calcium, Phosphorous
(d) Carbon, Hydrogen, Potassium

70. In order of their distance from the Sun, which of the following planets lie between Mars and Uranus?
(a) Earth and Jupiter
(b) Jupiter and Saturn
(c) Saturn and Earth
(d) Saturn and Neptune

71. "It consists of Hydrogen and Helium, as these are the most common and stable compounds in the Universe. These massive collections of hydrogen gas are pulled together by gravity to form star nurseries through the process of fusion."

The information given in above paragraph refers to which of the following:
(a) Pulsar
(b) Nebulae
(c) Planetary Nebulae
(d) Quasar

72. Which of the following is the reason behind the gaseous nature of Outer planets?
(a) These planets have lower gravity as compared to inner planets.
(b) The presence of rings which are composed mainly of gases like hydrogen and helium.
(c) They have captured a large amount of hydrogen and other gasses from the surrounding nebula.
(d) The cores of all these planets are made of gaseous compounds.

73. Consider the following statements
1. There is absence of atmosphere on the Moon.
2. Meteoroids that pass close to the Moon are easily vaporized.
3. Impact crater on the lunar surface is mainly due to plate tectonics.

Which of the statements given above is/are ***incorrect***?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

74. Which of the following is *not* the correct reason behind the habitable nature of earth?
(a) Presence of Goldilocks zone.
(b) Presence of an active plate tectonic system.
(c) It is orbiting a high-mass star.
(d) Presence of molten core inside the earth.

75. Through which one of the following groups of countries does the Equator pass?
(a) Brazil, Zambia and Malaysia
(b) Colombia, Kenya and Indonesia
(c) Brazil, Sudan and Malaysia
(d) Venezuela, Ethiopia and Indonesia

76. Consider the following statements:
1. Total land area of Earth is approximately 1475 lakh square kilometres.
2. Maximum percentage of Earth's water is in the Pacific Ocean.

Which of the statements given above is/are correct?
(a) 1 only

(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

77. Consider the following statements with reference to evolution of earth:

1. Gravitational compression and radioactive decay contributed to the molten state of earth in its initial stage of evolution.
2. Asteroids that slammed into Earth and other inner planets contained a significant amount of water in their minerals.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

78. Which one of the following is the correct sequence of the given Continents in the decreasing order of their percentage of Earth's land?

(a) North America - Africa - South America – Europe
(b) Africa - North America - South America - Europe
(c) North America - Africa - Europe - South America
(d) Africa - North America - Europe - South America

79. Consider the following events during the "evolution of the earth":

1. Degassing
2. Differentiation of earth forming material.
3. Photosynthesis
4. Loss of primordial atmosphere.

What is the correct chronological order of the above events, starting from the earliest time?

(a) 4-2-1-3
(b) 4-1-2-3
(c) 4-1-3-2
(d) 2-4-1-3

80. Consider the following statements:

1. Evidence of volcanism has been found in every terrestrial planet of our solar system.
2. Most of the volcanic activity on earth occurs along the mid-ocean ridges.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

SOLUTIONS

1.1. Universe & the Evolution of Earth

1. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is incorrect. The Sun rises in the East and sets in the West because of the rotation of the Earth in an anticlockwise direction from West to East. So, the fact that the Sun rises in the East and sets in the West **provides evidence to the rotation of the Earth on its axis** (and not of sphericity of Earth).

Statement 2 is correct. When a Ship appears over the distant horizon, the mast is seen first before the hull. This is because of the spherical shape of Earth. If the Earth were flat, the entire ship would have been seen all at once.

Statement 3 is incorrect. The moon appears to change shape each night. The different shapes of the Moon that we see at different times of the month are called the Moon's phases.

The Moon does not produce its own light. We are able to see the Moon due to the Sun's light illuminating the Moon. On Earth, our view of the illuminated part of the Moon changes each night, **depending on where the Moon is in its orbit,** or path, around Earth. **Thus, the phases of the Moon are caused by the changing positions of the Moon around the Earth**. As the Moon goes around the Earth, different parts of it are illuminated by the Sun. But because the same side of the Moon always points toward Earth, most of the time some of the illuminated part (daytime on the Moon) faces away from us. And, some of the non-illuminated part (nighttime on the Moon) faces toward us. This creates the different phases of the Moon.

Statement 4 is incorrect. Earth's tilted axis causes the seasons. Earth has seasons because its axis is tilted. When the North Pole tilts toward the Sun, it's summer in the Northern Hemisphere. And when the South Pole tilts toward the Sun, it's winter in the Northern Hemisphere.

So, **the occurrence of day and night on Earth provides evidence to the tilted axis of Earth** (and not of sphericity of Earth).

2. Solution: (d)

Exp) Option d is the correct answer.

During the **summer solstice (around June 20-21), the Northern Hemisphere experiences its longest day of the year.** This is due to the Earth's axial tilt of approximately 23.5° toward the Sun, causing the Sun to appear directly overhead at the Tropic of Cancer (23.5°N latitude). As a result, **locations farther north receive longer daylight hours compared to those closer to the equator**.

1. **Jaipur (26.5°N latitude)** is the northernmost city among the given options. Because of its higher latitude, **Jaipur experiences longer daylight hours during the summer solstice compared to the other cities**. The farther a city is from the equator, the greater the variation in the length of day and night throughout the year.
2. **Thiruvananthapuram (8.5°N latitude)** is located near the equator. Cities close to the equator experience almost equal day and night durations throughout the year, with minimal seasonal variation in daylight hours. Therefore, it has the shortest daylight duration among the options during the summer solstice.
3. **Hyderabad (17.4°N latitude)** and **Pune (18.5°N latitude)** are farther north than Thiruvananthapuram but south of Jaipur. While they experience slightly longer daylight during the summer solstice, their duration is still shorter than Jaipur's because of their lower latitude.

3. Solution: (d)

Exp) Option d is the correct answer.

An equinox is an event when the Sun passes directly above the Equator. On 21st March and September 23rd, direct rays of the sun fall on the equator. At this position, neither of the poles is tilted towards the sun; so, **the whole earth experiences nearly equal days and equal nights.** Equinoxes are the only times of the year when the Sun is directly above the Equator. So, the equinoxes are the only time when both the Northern and Southern Hemisphere experience roughly equal amounts of daytime and nighttime.

Option d is correct. The axis of the Earth is tilted at an angle of 66.5 degrees with respect to its orbital plane and thus 23.5 degrees to the vertical plane. The reason behind variations in the length of day and night throughout the Earth is the **revolution of Earth on this tilted axis**. If the axis of the Earth is not tilted, then Earth every location will have equal lengths of daytime and nighttime throughout the year.

If the axis of the Earth is perpendicular to the orbital plane, all parts of Earth would have equal days and equal nights throughout the year.

4. Solution: (b)

Exp) Option b is the correct answer.

Twilight is the period of **time between sunset and complete darkness**, in which the **atmosphere is partially illuminated** by the sun, being neither totally dark nor completely lit. This illumination is caused **by diffused or refracted light coming from the Sun**, which is still below the horizon.

The period between sunrise and full daylight is called Dawn.

Statement I is correct. The **period of dawn and twilight increases while moving from equator to poles.** So, places at higher latitudes would experience longer twilights as compared to those at lower latitudes.

Statement II is correct but does not explain statement I. Earth rotates faster at the Equator than it does at the

poles. Every point on Earth takes the same amount of time—24 hours—to make a complete rotation. Yet points along the equator have to travel a much longer distance than points near the poles and, therefore, move at a higher speed. Equatorial regions race nearly 1,600 kilometers (1,000 miles) per hour, whereas near the poles the planet rotates at a slow 0.00008 kilometers (0.00005 miles) per hour.

But, this does not explain why twilight is longer over the poles than the Equator.

Correct Reason: In the middle and high latitudes the duration of twilight is long because at these latitudes **the Sun has an inclined path.**

The sun rises and sets in a vertical path at the Equator. Hence, the period of refracted light is short.

But in higher latitudes, the Sun rises and sets in an oblique path. Hence, the period of refracted light is longer.

5. Solution: (a)

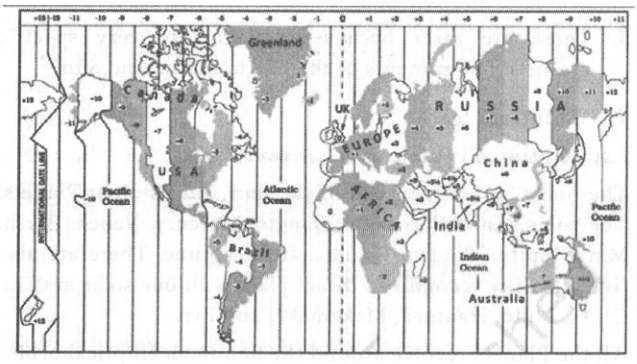
Exp) Option a is the correct answer.

The ship's local time is **5 hours and 30 minutes ahead of GMT.** This time difference corresponds to the Indian Standard Time (IST), which is **GMT+5:30. The Bay of Bengal borders India, making it the most likely location. The Red Sea and the Mediterranean Sea** are located in time zones closer to GMT, while the Atlantic Ocean, being from where GMT passes, cannot be 10:30 AM local time.

6. Solution: (d)

Exp) Option d is the correct answer.

The International Date Line (IDL) is an imaginary line on the Earth's surface that defines the boundary between one calendar day and the next. It plays a crucial role in managing the transition of time as we travel around the globe.



Option 1 is correct: Tuvalu is located in the central Pacific Ocean and is **entirely west of the IDL.**

Option 2 is correct: Vanuatu is a double chain of 13 principal and many smaller islands in the south-western Pacific Ocean. The islands are volcanic and coral in origin. They lie about 800 kilometres west of Fiji and nearly 1800 kilometres east of Australia. It is **located west of the International Date Line.**

Option 3 is correct: In 1995, Kiribati moved its eastern islands (including the Line Islands) to the west of the IDL for administrative consistency. This means that all of **Kiribati is west of the IDL.**

Option 4 is correct: Tonga is located **west of the IDL.**

Option 5 is correct: Samoa is a small island country in the central South Pacific Ocean. It is made up of an archipelago of nine islands, four of which are inhabited. The two largest islands are Savai'i and Upolu. Samoa is located **west of the IDL.**

7. Solution: (c)

Exp) Option c is the correct answer.

Dark matter is a **hypothetical form of non-luminous matter thought to account for approximately 85% of the matter in the universe and about a quarter of its total energy density.** It's called "dark" because it doesn't interact with the electromagnetic force, meaning it doesn't emit, absorb, or reflect light, making it invisible to telescopes and other conventional detection methods.

Statement-I is correct: Dark matter doesn't interact with light or other electromagnetic radiation, **making it invisible to our telescopes and detectors.** We can only infer its presence through its gravitational effects on visible matter, like galaxies and galaxy clusters.

Statement-II is correct:The electromagnetic force governs interactions between electrically charged particles, including light. Because dark matter doesn't participate in electromagnetic interactions, it doesn't emit, absorb, or reflect light. This lack of interaction is the primary reason it's "dark" and difficult to detect directly.

Statement-III is incorrect: Scientists believe that **dark matter does possess mass. The evidence for dark matter comes from its gravitational influence. We observe galaxies rotating faster than they should if they only contained the visible matter we see.** The extra gravitational pull needed to hold these galaxies together suggests the presence of unseen mass—dark matter. Without mass, dark matter could not exert this gravitational influence.

Statement-II explains Statement-I: The fact that dark matter doesn't interact with the electromagnetic force is a major reason why it's so difficult to identify dark matter.

8. Solution: (d)

Exp) Option d is the correct answer.

Statement-I is correct: While **Mercury is closer to the Sun, Venus's dense atmosphere, primarily composed of carbon dioxide, traps heat through a powerful greenhouse effect.** This greenhouse effect causes the surface temperature of Venus to reach extremely high levels, far exceeding those of Mercury. Therefore, **Venus is the hottest planet in our solar system.**

Statement-II is incorrect:Mercury holds the position of being the closest planet to the Sun. Venus is the second planet from the Sun, located between Mercury and Earth.

Statement-III is incorrect: Venus has a **very thick and dense atmosphere.** This atmosphere is a major factor in its high surface temperatures. It is primarily made up of carbon dioxide, with clouds of sulfuric acid. This dense atmosphere is what creates the intense greenhouse effect, which is the primary reason Venus is so hot.

9. Solution: (b)

Exp) Option b is the correct answer.

The **Earth's magnetic field** is generated by the movement of molten iron and other metals in the outer core, a process known as the **Geo dynamo**.

1. This **magnetic field is not static**; it undergoes gradual shifts, causing the magnetic poles to drift over time.
2. Occasionally, the poles may even reverse in an event called a **Geomagnetic reversal**, though this happens over thousands to millions of years.

The shifting of magnetic poles can have significant effects on natural and technological systems.

Option 1 is correct: Many migratory birds, as well as sea turtles, butterflies, and some fish, **rely on the Earth's magnetic field to navigate** across long distances.

1. This ability, known as **magnetoreception,** helps them determine their direction.
2. Changes in the magnetic poles can alter the magnetic field's intensity and pattern, potentially confusing these animals and disrupting their migration routes.
3. This is a well-documented impact of changes in Earth's magnetism.

Option 2 is correct: Many **navigation systems** and instruments, especially compasses and those **used in aviation and marine navigation**, do **depend on Earth's magnetic field**. Sudden or irregular shifts in the magnetic poles can create discrepancies and errors in these systems.

Option 3 is incorrect: Earthquakes occur due to the movement of tectonic plates, which is driven by processes within Earth's mantle and lithosphere.

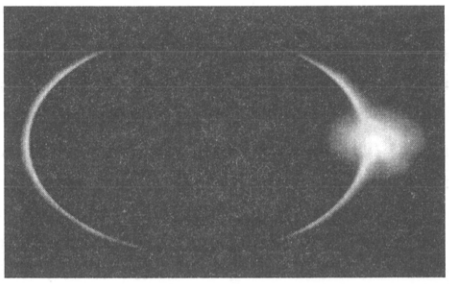
1. The shifting of magnetic poles is caused by changes in the motion of molten iron in the outer core, which does not influence tectonic activity.
2. There is **no scientific evidence linking magnetic pole shifts to an increase in earthquake frequency.**

Option 4 is incorrect: Gravity is determined by the mass of the Earth and the distance between objects, not by its magnetic field.

1. Since the shifting of magnetic poles does not alter Earth's mass or density, it has no effect on gravity.
2. The **force of gravity remains constant regardless of changes in the magnetic field.**

10. Solution: (d)

Exp) Option d is the correct answer.



Annular Solar Eclipse

Statement 1 is correct: The Moon's orbit around the Earth is elliptical, meaning that its distance from Earth varies throughout its orbit.

1. **Apogee** is the point where the **Moon is farthest from Earth in its orbit**, while the closest point is called the **perigee.**
2. An **Annular Solar Eclipse** occurs when the **Moon comes between the Earth and the Sun**, but its apparent size is **smaller** than that of the Sun. This happens because the Moon is at or near its **apogee**.
3. This smaller apparent size means that the Moon cannot completely block the Sun's disc, which leads to the unique **"Ring of Fire" effect**, where the edges of the Sun remain visible.

Statement 2 is correct: In an **annular solar eclipse, the most notable feature** is precisely the **"Ring of Fire" phenomenon**.

1. During an **annular solar eclipse,** when the Moon passes directly in front of the Sun but is too small to cover it completely, the outer edges of the Sun remain visible as a **bright ring encircling the Moon.**
2. This creates a stunning visual effect often referred to as the **"Ring of Fire."**
3. This phenomenon is **not observed in total solar eclipses**, where the Moon completely covers the Sun.

Statement 3 is correct: Annular Solar Eclipses are **relatively common, occurring at least once every 1 to 2 years** somewhere on Earth.

1. **Hybrid solar eclipses**, on the other hand, are **very rare, occurring once in a decade**.
2. Hybrid solar eclipses occur when an eclipse transitions between a total eclipse and an annular eclipse due to the curvature of the Earth.
3. These are rarer because they require very specific geometric alignments of the Earth, Moon, and Sun.

11. Solution: (a)

Exp) Option a is the correct answer.

The Solar System consists of the Sun and its eight Planets. The solar system has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. There are also five officially recognized dwarf planets in our solar system: Ceres, Pluto, Haumea, Makemake, and Eris.

All the Planets revolve around the Sun in an elliptical orbit.

These planets also rotate on their own axis. **All planets, except Venus and Uranus, rotate on their axis in the anticlockwise direction.**

Option 1 is incorrect. Mercury rotates on its axis in an anticlockwise direction. Since it rotates in an anti-clockwise direction, the Sun appears to rise in the east and set in the west. Mercury completes one rotation every 59 Earth days.

Mercury is the smallest planet in our solar system and nearest to the Sun. Despite its proximity to the Sun, Mercury is not the hottest planet in our solar system. Mercury revolves around the Sun every 88 days.

Option 2 is correct. Venus rotates slowly in a clockwise manner around its axis. Venus rotates in a clockwise direction and as a result the Sun appears to rise in the west and set in the east. Venus is the second planet from the Sun, and our closest planetary neighbor. It's the hottest planet in our solar system, and is sometimes called Earth's twin.

Option 3 is incorrect. The Earth rotates in an anti-clockwise manner around its axis. Since it rotates in an anti-clockwise direction, the Sun appears to rise in the east and set in the west. As Earth orbits the Sun, it completes one rotation every 23.9 hours. Earth's axis of rotation is tilted 23.4 degrees with respect to the plane of Earth's orbit around the Sun.

Earth is the third planet from the Sun, and the fifth largest planet. It's the only place we know of inhabited by living things.

Option 4 is correct. Uranus rotates slowly in a clockwise manner around its axis. Uranus rotates in a clockwise direction and as a result the Sun appears to rise in the west and set in the east. **Uranus rotates at a nearly 90-degree angle from the plane of its orbit**. Uranus takes about 17 hours to rotate, or spin once around its axis.

Uranus is the seventh planet from the Sun, and it has the third largest diameter of planets in our solar system. Uranus appears to spin sideways. Uranus is very cold and windy.

Option 5 is incorrect. The Saturn rotates in an anti-clockwise manner around its axis. Since it rotates in an anti-clockwise direction, the Sun rises in the east and sets in the west. Saturn has the second-shortest day in the solar system. One day on Saturn takes only 10.7 hours.

Saturn is the sixth planet from the Sun, and the second-largest planet in our solar system. Saturn is the only planet to have rings.

12. Solution: (c)

Exp) Option c is the correct answer.

Option a is incorrect: The exchange of energy between matter, such as walls, and radiation within a cavity occurs in discrete bundles of specific sizes. This quantum of energy exchange is directly proportional to the frequency (ν) of the radiation. The energy of an oscillator with frequency ν is always an integral multiple of **hν**, where **h** is a fundamental constant known as Planck's constant, with a value of 6.626×10^{-34} Js.

Option b is incorrect: The Cosmological Constant (Λ) was originally introduced in Einstein's field equations of general relativity to allow for a static universe. However, later observations confirmed the universe is expanding, leading to the reconsideration of Λ as a factor in cosmic acceleration rather than a direct measure of expansion.

Option c is correct: The Hubble Constant quantifies the current expansion rate of the universe. It is expressed in kilometers per second per megaparsec (km/s/Mpc), where a megaparsec equals 3.26 million light-years. This constant is fundamental to understanding the age and evolution of the universe.

Option d is incorrect: Stefan's Constant (σ) is associated with blackbody radiation, describing the rate at which a perfect blackbody emits radiant energy per unit area. Mathematically, it is given by $E = \sigma T^4$, where $\sigma = 5.672 \times 10^{-8}$ $Jm^{-2}K^{-4}s^{-1}$. This law is important in thermal physics but does not relate to the expansion of the universe.

13. Solution: (b)

Exp) Option b is the correct answer.

Option b is correct: A **Planet Parade, also** called **Planetary alignments,** refers to an astronomical event during which **multiple planets in our solar system are visible in the night sky at the same time.** However, Planet Parade is not a technical term in astronomy.

1. Planet Parade occurs when the planets align on one side of the Sun, making them observable from Earth with the naked eye, or sometimes with the help of a telescope.
2. In **February, 2025**, a remarkable planetary parade occurred, allowing observers to witness seven out of the eight planets—Mercury, Venus, Mars, Jupiter, Saturn, Uranus, and Neptune—visible simultaneously after sunset.

Option a is incorrect: Planets have elliptical orbits with varying distances from the Sun at different points in time. There is **no natural phenomenon** where **multiple planets align in such a way** that they are all **equidistant from the Sun at the same time.**

Option c is incorrect: Planetary orbits are highly stable due to the gravitational pull of the Sun. While gravitational interactions between planets do occur over long periods, they **do not cause planets to "shift" their orbits**. Such interactions, known as **orbital resonances**, happen over millions of years and are unrelated to Planet Parade.

Option d is incorrect: Planetary alignments do not naturally form a circular or symmetrical pattern in the sky. Their arrangement is determined by their orbital paths, which are not evenly spaced or positioned to create geometric shapes. While planets may appear clustered together during a parade, they do not form perfect symmetrical patterns like a circle.

Important Tips

Planet Parade in the Context of Astrology:

In astrology, a Planet Parade refers to an event where **multiple planets align in the same zodiac constellation.** Astrologers interpret such configurations as having significant impacts on individual horoscopes and global events, depending on the planets involved and the zodiac signs they occupy.

14. Solution: (c)

Exp) Option c is the correct answer.

The Chandrasekhar Limit is named after astrophysicist Subrahmanyan Chandrasekhar. He received the Nobel Prize for his theoretical work about the gravitational collapse of stars.

Option c is correct.

'The Chandrasekhar Limit' – explained the maximum mass of a stable white dwarf star.

Stars can end their lives as slowly cooling stellar embers known as white dwarfs or they can go on for supernova explosions. They will go on to explode in massive cosmic blasts called supernovas creating a neutron star or even a black hole.

The Chandrasekhar limit determines whether a star ends its life as a smoldering white dwarf, or explodes in a supernova to become a neutron star or black hole.

The Chandrasekhar value for a white dwarf star is generally considered to be 1.4 times the mass of the Sun.

White dwarfs are stars that have burned up all of the hydrogen they once used as nuclear fuel.

15. Solution: (a)

Exp) Option a is the correct answer.

Indian Institute of Astrophysics in Bengaluru under the blazing Sun celebrated Zero Shadow Day on 24 April 2024.

Statement I is correct. Zero Shadow Day **is a phenomenon where the sun is exactly overhead, and vertical objects appear to cast no shadow.** The Sun will be exactly overhead at noon and will not cast a shadow of an object on the ground. It happens twice a year **for every point on Earth between the Tropic of Cancer and the Tropic of Capricorn. It does not occur at places beyond the tropics. So, Bengaluru will experience a Zero Shadow Day, while New Delhi will never.**

Statement II is correct and explains statement I. When the Sun is directly overhead, the shadow of a vertical object falls under it, and hence no shadow will be seen at local noon. Hence, the Zero Shadow Day (ZSD) will occur. The sun is directly overhead only at places within the tropics. Bengaluru lies within the tropics whereas New Delhi beyond.

It occurs due to the tilt of the Earth's axis and its orbit around the Sun.

16. Solution: (b)

Exp) Option b is the correct answer.

Hubble Tension is the name given to differences in measurements of the rate of the expansion of the Universe.

Option b is correct. The Hubble Tension refers to the discrepancy between measurements of the universe's expansion rate by Cosmic Distance Ladder (CDL) and Cosmic Microwave Background (CMB).

We can measure the rate of the Universe's expansion by two different methods. One is the Cosmic Distance Ladder (CDL) and other is the Cosmic Microwave Background (CMB).

Cosmic Distance Ladder (CDL) measures the rate of universe expansion by observing the distance of objects in the nearby Universe and how fast they are moving away from us.

Cosmic Microwave Background (CMB) measures the rate of expansion by measuring fluctuations in the cosmic microwave background.

We'd expect both methods to agree but this is not. We find Cosmic Distance Ladder suggest a different rate of expansion than Cosmic Microwave Background. As per the CDL, the nearby universe is expanding at the rate of 73-74 km/s/megaparsec, whereas the CMB states that the distant universe is expanding at the rate of 67-68 km/s/megaparsec. This **difference is called the Hubble Tension.**

17. Solution: (a)

Exp) Option a is the correct answer.

The solar system consists of the Sun and eight planets, believed to have formed about 4.6 billion years ago. The nebula from which our Solar system is supposed to have been formed, started its collapse and core formation some time 5-5.6 billion years ago and the planets were formed about 4.6 billion years ago.

Statement 1 is correct: Moons, also known as natural satellites, vary in shapes, sizes, and characteristics. **Among the rocky inner planets, Mercury and Venus have no moons**, Earth has one, and Mars has two small moons. In contrast, the gas giants Jupiter and Saturn, as well as the ice giants Uranus and Neptune, boast numerous moons.

Statement 2 is incorrect: All gas giant planets, including Jupiter, Saturn, Uranus, and Neptune, are encircled by rings. Among them, Saturn, the second-largest planet, boasts prominently visible rings. Thus, **Saturn is not the only planet to have rings,** but none are as spectacular or as complex as Saturn's.

Statement 3 is incorrect: Asteroids, also known as minor planets, are rocky remnants remaining from the initial stages of our solar system's formation approximately 4.6 billion years ago. **The majority of identified asteroids orbit the Sun within the main asteroid belt, situated between Mars and Jupiter.** The asteroids can be found beyond the asteroid belt:

1) Trojan asteroids: Trojan asteroids are small celestial bodies that share the orbit of a larger body, such as a planet or large moon. Eg: Jupiter's Trojan Asteriods.
2) Near-Earth asteroids: Asteroids that have been knocked out of the main belt by collisions or Jupiter's gravity.
3) Asteroids captured by a planet's gravitational pull: These asteroids can be pulled out of the belt and orbit the planet as a moon.

18. Solution: (a)

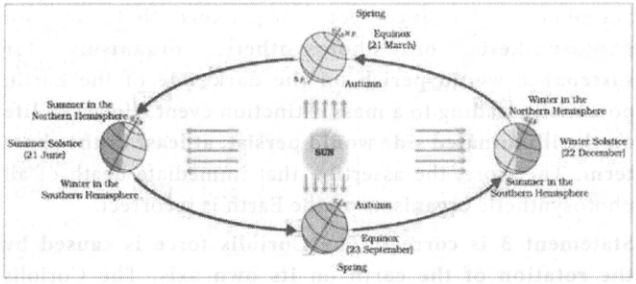
Exp) Option a is the correct answer.

The term "equinox" comes from Latin, meaning "equal night," highlighting the balance between duration of day and night experienced during this time. Equinoxes mark the transition points between the seasons, specifically between winter and spring (the spring equinox) and between summer and autumn (the autumn equinox). These transitions occur due to the tilt of the Earth's axis and its orbit around the Sun.

Statement-I is correct: An equinox happens when the Sun's direct rays cross the equator of a planet. The equinoxes are the only time when both the Northern and Southern

Hemisphere experience roughly equal amounts of daytime and night-time. This happens because the **Sun is directly above the Earth's equator, meaning both hemispheres receive nearly the same amount of sunlight.**

During the **summer solstice in the Northern hemisphere**, the tilt of the Earth's axis is such that **the North Pole is tilted towards the Sun,** resulting in the longest day and shortest night of the year in the Northern Hemisphere. In contrast, during the **winter solstice in the Northern Hemisphere, the North Pole is tilted away from the Sun**, resulting in the shortest day and longest night of the year in the Northern Hemisphere.

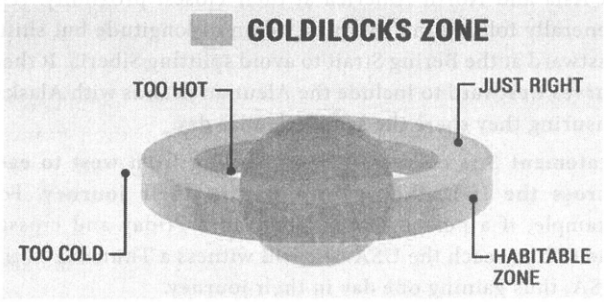


Statement-II is correct, and it is the correct explanation for the Statement-I: On Earth, there are two equinoxes every year: one around March 21 and another around September 22. During an equinox, **Earth's axis, tilted at 23.5°, neither leans towards or away from the sun**, thus all the areas receiving equal amounts of Sunlight and resulting in approximately equal day and night lengths for both hemispheres.

19. Solution: (a)

Exp) Option a is the correct answer.

Goldilocks zone is also called as the 'habitable zone'. It is an area around a star where it is **neither too hot nor too cold for liquid water to exist** on the surface of surrounding planets. If a planet is too close to its star, the heat from the star would cause all water to evaporate into steam. Conversely, if a planet is too far from its star, the temperatures would be too cold, causing water to freeze solid. In the Goldilocks zones, the energy from the star (together with the greenhouse effect generated by the planet's atmosphere) would produce a surface temperature between 0 and 100°. These are the regions **potentially suitable for life**. For example, the **Earth is within the habitable zone of the Sun.** Rocky exoplanets found in the habitable zones of their stars are more likely targets for detecting liquid water on their surfaces.



Knowledge Base: **Astrobiology** is the study of the **origin, evolution, and distribution of life in the universe.** It combines principles from various disciplines such as **astronomy, biology, chemistry, geology, and planetary science** to investigate the potential for life elsewhere in the universe. By studying the conditions for life on Earth and beyond, astrobiologists aim to **unravel the mysteries of life's origin and its potential for existence elsewhere in the universe.**

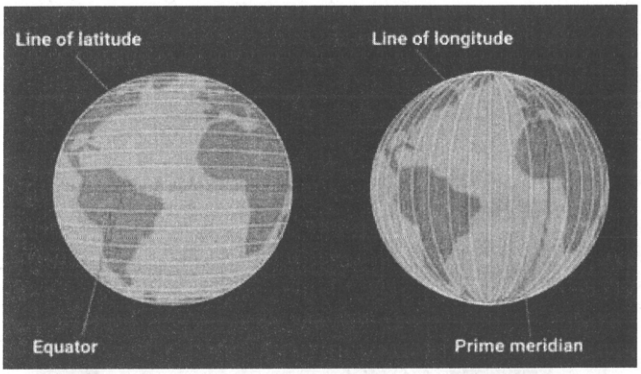
20. Solution: (b)

Exp) Option b is the correct answer.

Latitude and longitude are imaginary lines that help geographers and cartographers locate places on the globe.

1) Latitude lines run east and west, starting at 0° at the equator and increasing to 90°North or 90°South. Latitudes are horizontal lines that measure distance north or south of the equator. Totally there are 180 latitudes.
2) Longitude lines (called meridians) run north and south and circle the planet from pole to pole. Longitudes are vertical lines that measure east or west of the meridian in Greenwich, England.. Totally there are 360 Longitudes.

Statement 1 is incorrect: The distance between any two adjacent latitudes is approximately 69 miles or 111 km. Latitude lines run parallel to each other. That's why the distance between them **remains constant** from the South to the North pole.



Statement 2 is correct: Longitude lines are furthest apart at the equator and meet at the poles. The degree of longitude is widest at the equator with a distance of 69.172 miles or 111.321 kilometers. The **distance between longitudes decreases** as we move away from the equator towards the poles.

21. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct. Axial tilt determines the **length of daylight** at any point on the earth. The 23.5 degrees of tilt and the position of the north pole relative to the sun matters in this case. When the pole is tilted towards the sun, daylight is longer than when it is pointed away and vice-versa.

Option b is *incorrect*. Earth's axial tilt (also known as the obliquity of the ecliptic) is about 23.5 degrees. Due to this axial tilt, the sun shines on different latitudes at different

angles throughout the year. This **causes the seasons on Earth.**

Option c is *incorrect*. Uranus has the largest axial tilt in the solar system. Its axis is tilted about 98 degrees, so its north pole is nearly on its equator. Astronomers suspect that this extreme tilt was caused by a collision with an Earth-sized planet billions of years ago, soon after Uranus formed.

Option d is *incorrect*. Without axial tilt, equator would have had **more temperature than the poles** and not otherwise. It would still be warm at the equator and cold at the poles. The most profound impact on temperatures would be at the poles. Instead of dark and frigid temperatures in the winter and warmer and constant sun in the summer, the **polar areas** would have much more **uniform temperatures year-round** and the **sun** would always be **low on the horizon.**

22. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: Circle of Illumination is a hypothetical line that divides the day and night on the Earth's surface at any given time.

Statement 2 is incorrect: Circle of Illumination **does not coincide with the axis of the Earth**, which is the imaginary line that the Earth rotates around. The circle of illumination is at an angle of 23.5° to the axis of the Earth, because the Earth is tilted on its axis. This tilt causes the circle of illumination to change its position throughout the year, resulting in different seasons and lengths of day and night in different regions of the Earth.

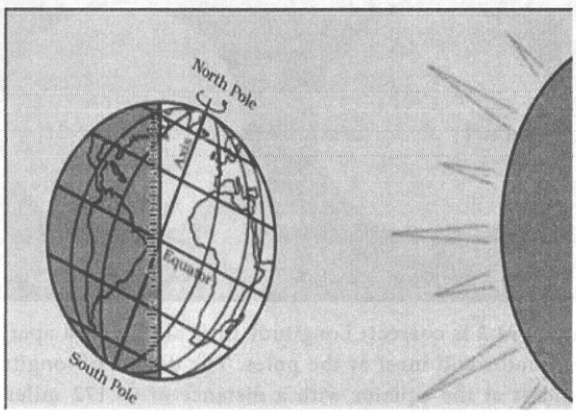


Figure 3.2 : Day and Night on the Earth due to rotation

Statement 3 is correct: Equal day lengths occur at the equator throughout the year. This is because the circle of illumination cuts the equator exactly in half at all times, regardless of the Earth's tilt. As a result, the equator experiences approximately 12 hours of sunlight and 12 hours of darkness every day. However, it cuts all other latitudes unequally, resulting in unequal periods of day and night except for the equinoxes.

23. Solution: (b)

Exp) Option b is the correct answer.

The movement/motion of the Earth plays a fundamental role in shaping the climate of earth and its biodiversity and it has two types of motions, namely **rotation and revolution**. Rotation is the movement of the earth on its axis. The movement of the earth around the Sun in a fixed path or orbit is called Revolution. Following are some of the consequences, if the earth stops rotating:

Statement 1 is correct: Day and night change we experience is the result of rotation of earth along its own axis. Hence if earth stops rotating, the portion of the earth facing the sun would always experience day, thus bringing continuous warmth to the region. The other half would remain in darkness and be freezing cold all the time.

Statement 2 is incorrect: Organisms that rely on photosynthesis or photosynthetic organisms for sustenance would perish on the dark side of the Earth, potentially leading to a mass extinction event. However, **life on the illuminated side would persist, at least in the short term**. Therefore, the assertion that immediate death of all photosynthetic organisms on the Earth is incorrect.

Statement 3 is correct: The Coriolis force is caused by the rotation of the earth on its own axis. The Coriolis force intervenes and causes the water to move to the right in the northern hemisphere and to the left in the southern hemisphere. Hence **without rotation of earth movement of Ocean waters across the globe would be affected majorly.**

24. Solution: (c)

Exp) Option c is the correct answer.

Longitude is a geographical coordinate that measures the angular distance of a location east or west of the Prime Meridian. Prime Meridian is a reference line that runs from the North Pole to the South Pole and is assigned a longitude of 0 degrees.

Statement 1 is incorrect: The International Date Line (IDL) is an imaginary line passing through the Pacific Ocean roughly along the 180 degrees longitude. It is a Zig Zag line to accommodate political boundaries and practical considerations. It serves as the demarcation line where the calendar date changes by one day when crossing from one side to the other.

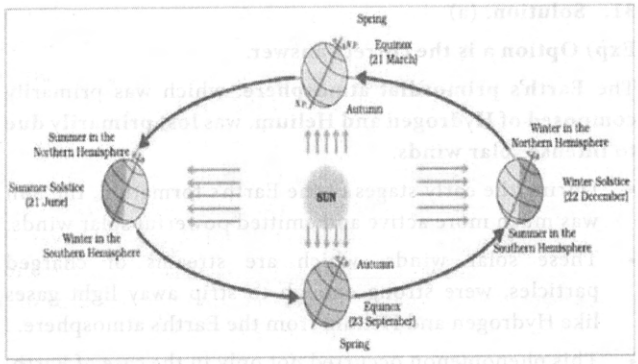
Statement 2 is correct: The International Date Line **(IDL)** that runs from North pole to the South pole along the 180-degree longitude, does **pass through the Bering strait. This strait connects the Arctic Ocean with the Bering Sea** and serves as the demarcation line between the continents of Asia and North America at their closest proximity. IDL generally follows the 180th meridian of longitude but shifts eastward at the Bering Strait to avoid splitting Siberia. It then curves westward to include the Aleutian Islands with Alaska, ensuring they share the same calendar day.

Statement 3 is correct: When traveling from **west to east across the IDL, they gain a day in their journey.** For example, if a person leaves Japan on a Friday and crosses the IDL to reach the USA, she will witness a Thursday in the USA, thus gaining one day in their journey.

25. Solution: (a)

Exp) Option a is the correct answer.

A solstice occurs twice a year when the Sun reaches its highest or lowest point in the sky relative to the celestial equator. The summer solstice occurs around June 21st in the Northern Hemisphere and marks the longest day. On the other hand, the winter solstice occurs around December 21st in the Northern hemisphere and marks the shortest day.



Statement 1 is correct: The onset of summer solstice (June 21) in the Northern hemisphere marks the beginning of Dakshinayan as per the Indian cultural traditions. Dakshinayan is a period of six months during which the Sun moves southward on the celestial sphere in between the Summer and the Winter solstice.

Statement 2 is correct: During the summer solstice, the North Pole of the Earth points more directly toward the Sun than at any other time during the year. This results in summer for the Northern Hemisphere. Conversely, during the **Winter solstice (December 22)**, the **North Pole of the Earth is pointed away from the Sun** than at any other time during the year, resulting in summer for the Southern hemisphere.

Statement 3 is incorrect: During the summer solstice in the Northern Hemisphere, **the amount of sunlight received by a particular area depends on its latitude**. For instance, areas near the Arctic Circle, the sun does not set, resulting in continuous daylight during the summer solstice.

26. Solution: (c)

Exp) Option c is the correct answer.

Statement-I is correct: The **gravitation force (g)** is not the same at different latitudes on the surface. It **is greater near the poles and less at the equator.** The Earth is not a perfect sphere but rather bulges at the equator. This means that the poles are closer to the Earth's centre. There is an inverse relationship between distance and gravitational force.

Statement-II is incorrect: The gravitation force is greater near the poles and less at the equator because **the distance from the centre at the equator is greater than that at the poles.** The gravity values also differ according to the mass of materials. The uneven distribution of mass of material within the earth influences this value.

- The reading of gravity at different places is influenced by many other factors. These readings differ from the expected values. Such a difference is called a gravity anomaly.
- Gravity anomalies provide information about the distribution of mass of the material in the crust of the earth.

27. Solution: (a)

Exp) Option a is the correct answer.

The steady-state theory of the origin of the universe was developed in 1948 by Fred Hoyle, Herman Bondi and Thomas Gold as an alternative to the Big Bang to explain the origin and expansion of the Universe.

Statement-I is correct: The steady state theory of the origin of the universe considers the universe to be roughly the same at any point of time. It is of the view that the **universe is always expanding but maintaining a constant average density.** A steady-state universe has no beginning or end in time, and from any point within it the view on the grand scale—i.e., the average density and arrangement of galaxies—is the same.

Statement-II is correct and is the correct explanation of Statement-I: As per the steady-state theory, as space expands, new matter is continuously created throughout the universe at a rate that precisely compensates for the decreasing density caused by the expansion of the universe. **Hence, it maintains a constant average density** and makes it appear as if the universe has always been the same. **As per this preposition, the matter is continuously created to form new stars and galaxies at the same rate that old ones become unobservable as a consequence of their increasing distance and velocity of recession.**

28. Solution: (d)

Exp) Option d is the correct answer.

Option d is correct: Planetesimals are **small, solid, rounded objects that formed during the early stages of the solar system's development.**

- As the gas cloud around the young Sun began to condense, particles of matter around the core clumped together to form these objects through a process known as **cohesion.**
- Initially, they existed as numerous smaller bodies, but in the final stages of planet formation, these planetesimals **accreted** to form fewer, larger bodies that eventually became **planets.**
- They are fundamental to the process of planet formation and are rightly called the **"building blocks of planets".**

Important Tips

Accretion discs are **rotating disks of gas and dust** that form around young stars or black holes. They are not solid objects like planetesimals but are composed of gas and dust particles. These discs play a crucial role in the formation of planets and other celestial bodies, as the material within the disc gradually coalesces to form larger bodies through accretion.

The Oort cloud is a shell of icy bodies that surrounds the solar system. It is believed to be a source of long-period comets. While it contains many small objects, the Oort Cloud is not involved in the process of the planet.

Planetoids, or minor planets, are **celestial objects that orbit the Sun** but are not dominant enough to be considered full-fledged planets. They are typically **larger than planetesimals** and smaller than planets and can include asteroids, dwarf planets, and other similar objects. Unlike moons, which orbit planets, planetoids orbit the Sun directly. They can be found throughout the solar system, including the asteroid belt, Kuiper belt, and Oort cloud

29. Solution: (a)

Exp) Option a is the correct answer.

Jovian planets, also known as gas giants, are the planets located outside the asteroid belt in our Solar System. These planets include Jupiter, Saturn, Uranus, and Neptune. They are fundamentally different from the terrestrial (inner) planets in terms of their composition, size, and atmospheric characteristics.

Statement 1 is correct: The **planets situated beyond the asteroid belt, which separates the inner (terrestrial) planets from the outer planets, are all classified as Jovian planets.** These include Jupiter, Saturn, Uranus, and Neptune. These planets are primarily composed of gases, making them significantly different from the terrestrial planets.

Statement 2 is incorrect: Although **Mercury and Venus have zero confirmed moons, Mars has two confirmed moons, Phobos and Deimos.** Earth has one moon.

Statement 3 is incorrect: Jovian planets have extensive atmospheres that are composed mainly of hydrogen, helium, and other gases. These atmospheres are much thicker and more prominent compared to those of terrestrial planets, contributing to the characteristic appearance of these planets.

30. Solution: (a)

Exp) Option a is the correct answer.

The Solar System consists of eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. These planets are orbited by numerous moons and accompanied by millions of smaller bodies, such as asteroids and comets, along with vast quantities of dust and gases.

Statement 1 is correct: Earth has a density of approximately 5.5 g/cm^3, which is higher than that of other planets in the Solar system such Mercury (5.4 g/cm^3) and Venus (5.2 g/cm^3),Jupiter (1.3 g/cm^3) and Saturn (0.7 g/cm^3) etc.

Statement 2 is incorrect: Saturn has the largest number of satellites in the solar system, not Uranus.

Statement 3 is incorrect: Uranus, not Neptune, is the third-largest planet in the Solar System. The largest planet is Jupiter, followed by Saturn in size. Neptune ranks as the fourth-largest planet.

The Solar System

	Mercury	*Venus*	*Earth*	*Mars*	*Jupiter*	*Saturn*	*Uranus*	*Neptune*
Distance*	0.387	0.723	1.000	1.524	5.203	9.539	19.182	30.058
Density@	5.44	5.245	5.517	3.945	1.33	0.70	1.17	1.66
Radius#	0.383	0.949	1.000	0.533	11.19	9.460	4.11	3.88
Satellites	0	0	1	2	about 53	about 53	about 27	13

* Distance from the sun in astronomical unit i.e. average mean distance of the earth is 149.598.000 km = 1 @ Density in gm/cm^3
\# Radius: Equatorial radius 6378.137 km = 1
Source: http://planetarynames.wr.usgs.gov/page/planets

31. Solution: (a)

Exp) Option a is the correct answer.

The **Earth's primordial atmosphere**, which was primarily **composed of Hydrogen and Helium**, was **lost primarily due to intense solar winds.**

- During the early stages of the Earth's formation, the Sun was much more active and emitted powerful solar winds.
- These solar winds, which are streams of charged particles, were strong enough to strip away light gases like Hydrogen and Helium from the Earth's atmosphere. .
- This phenomenon occurred not only in the case of Earth, but also in all the terrestrial planets.

32. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct. Comets are defined as icy bodies of frozen gases, rocks and dust. They orbit the sun in highly elliptical orbits that can take hundreds of thousands of years to complete. Comets have long tails. As a comet approaches close to the Sun, the frozen material in it starts evaporating. This evaporating material forms the tail of the comet. Comets appear dim as they move away from the Sun and then, it is not possible to see them with the naked eye.

Asteroids, sometimes called minor planets, are small rocky objects left over from the early formation of our solar system. Asteroids range in size from Vesta – the largest at about 329 miles (530 kilometers) in diameter – to bodies that are less than 33 feet (10 meters) across. Asteroids orbit the sun.

Statement 2 is incorrect. Asteroids are primarily found in the asteroid belt, a region between the orbits of Mars and Jupiter. On the other hand, comets typically originate from the outer reaches of the solar system, such as the Kuiper Belt and the Oort Cloud.

The Kuiper Belt is a doughnut-shaped region of icy objects beyond the orbit of Neptune

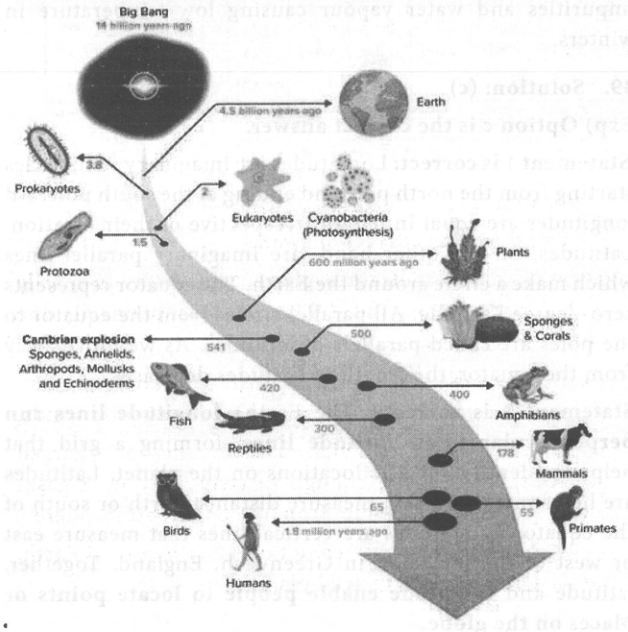
Statement 3 is incorrect. Both asteroids and comets revolve around the Sun. The motion of celestial bodies in our solar system is governed by gravitational forces, causing them to orbit the Sun. Therefore, asteroids and comets share this fundamental characteristic of orbiting the Sun.

33. Solution: (d)

Exp) Option d is the correct answer.

The correct chronological sequence in which the given organisms emerged on Earth, starting from the earliest is: Blue Green Algae- Fish- Amphibian- Reptiles

Option 3: Blue Green Algae first emerged on Earth around **2.5 to 3.8 billion years ago**



Option 1: Fishes first emerged on Earth between **438 to 505 Million years ago.**

Option 4: Amphibians first emerged on Earth between **360 to 408 Million years ago.**

Option 2: Reptiles first emerged on Earth between **286 to 360 Million years ago.**

34. Solution: (b)

Exp) Option b is the correct answer

Statement-I is correct: Only one side of the Moon is visible from the Earth. We always see the same side of the Moon. When we look at the Moon on a regular basis, its phases may change but we always see the same craters and other features of it .

Statement II is correct: The **Earth's slightly ellipsoidal shape is a result of its rotation on its axis.** When a planet rotates, it tends to form an oblate spheroid (a shape that is slightly flattened at the poles and bulging at the equator) rather than a perfect sphere. This is due to the centrifugal force exerted by the rotation about the Earth's axis. But it doesnot explain why only one side of the Moon is visible from the Earth.

Statement-III is correct and explains the Statement-I: Tidal locking occurs when the **gravitational forces between two celestial bodies, in this case, Earth and the Moon,** create a situation where the **rotation period of one body (the Moon) matches its orbital period around the other (Earth).** Earth's gravity causes a rocky tidal bulge in the Moon which effectively slowed down the Moon's rotational speed until it fell into equilibrium with its orbital period of Earth. The Moon rotates once every 27.3 days, which is the same amount of time it takes for the Moon to orbit our planet. As a result, the Moon always presents the same hemisphere towards Earth.

Hence Both statement -II and statement -III are correct, but only one of them explains statement -I.

35. Solution: (a)

Exp) Option a is the correct answer.

The Big Bang theory is a theory that attempts to explain the origin of the universe. It is also called the expanding universe hypothesis. It is the idea that **the universe began as just a single point, then expanded and stretched to grow** as large as it is right now, and it is still stretching.

Statement 1 is correct. The Big Bang theory says that the universe is expanding. **This expansion means that as time passes, galaxies move further and further apart.** The galaxies are moving away from each other. The farthest galaxies are moving faster than the ones that are close. Thus, **the distance between the galaxies is also found to be increasing** and thereby, the universe is considered to be expanding.

Statement 2 is incorrect. The expansion of the universe means an increase in space between the galaxies. It **does not mean that the size of the stars and planets is gradually increasing.** Galaxies, stars, planets and the things on them aren't getting bigger. Their size is controlled by the strength of the fundamental forces that hold atoms and sub-atomic particles together.

Statement 3 is incorrect. The universe has become transparent as a result of the expansion of the Universe. Until roughly 380,000 years after the Big Bang, the entire universe was a thick opaque cloud of plasma of electrons and nuclei. As the universe expanded, it cooled off enough to let the plasma become atoms, and the cosmos became transparent.

Important Tips

The Big Bang Theory proposed that:

- In the beginning, all matter forming the universe existed in the form of a "tiny ball" (singular atom) with an unimaginably small volume, infinite temperature and infinite density.
- At the Big Bang, the "tiny ball" exploded violently. This led to a huge expansion. The expansion continues even to the present day.
- As the universe grew, some energy was converted into matter. Within 300,000 years from the Big Bang, temperature dropped to 4,500 K (Kelvin) and gave rise to atomic matter. The universe became transparent.

36. Solution: (c)

Exp) Option c is the correct answer.

A large number of hypotheses were put forth by different philosophers and scientists regarding the origin of the earth. One such was Nebular Hypothesis.

Statement 1 is correct. Nebular Hypothesis was given to explain the origin of the solar system and Planets. The hypothesis considered that the solar system and planets **developed out of an interstellar cloud of dust and gas, called a nebula.**

Statement 2 is correct. It proposed that the sun was surrounded by solar nebula **containing mostly hydrogen and helium** along with what may be termed as dust. The friction and collision of particles led to formation of a disk-shaped cloud and the planets were formed through the process of accretion.

It proposed that the nebula flattened into a protoplanetary disk, and became a solar system consisting of a star with orbiting planets.

Particles of dust, floating in the disc were attracted to each other by static charges and eventually, gravity. As the clumps of dust became bigger, they interacted with each other—colliding, sticking, and forming proto-planets. The planets continued to grow over the course of many thousands or millions of years.

37. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: The Giant Impact hypothesis, also referred to as the **Big Splat Theory, describes the formation of the Moon as a result of the collision between the young Earth and a Mars-sized body that is called Theia.** The giant-impact model suggests that at some point in Earth's very early history, these two bodies collided. During this massive collision, nearly all of Earth and Theia melted and reformed as one body, with a small part of the new mass spinning off to become the Moon.

38. Solution: (c)

Exp) Option c is the correct answer.

Earth revolves around the sun at the speed of 66,600 m.p.h. One complete revolution takes approx. 365 days and 6 hours. The six hours then add to a day every four years, which is called a leap year.

Statement 1 is incorrect: It is due to rotation of earth and not revolution that earth experiences daytime and night-time. When the earth rotates on its axis, one portion of the earth faces daylight. Whereas the other portion which is away from the sun faces darkness.

Statement 2 is correct: Sun is vertically overhead at equator for two days each year.

Earth is tilted at 66.5 degrees with respect to the orbital plane. And it is due to earth's revolution around the sun in its elliptical orbit, that sun for two days each year is vertically above the equator. They usually fall on 21st march and 21st September and known as equinoxes.

Statement 3 is correct: Revolution of the earth on its tilted axis causes varying length in days and night. Earth is tilted on its axis and as earth revolves around the sun, the variation in length of days and night occurs. It also causes change in seasons.

Statement 4 is correct: Revolution of earth around the sun also causes change in season and its effect on temperature. In summer, the sun is higher on the sky than on the winter. As a result, the sunrays are concentrated on a small area, temperature therefore always rises in the summer. Whereas in winters, the slanted rays of sun fall indirectly over the earth. Also, much of the heat absorbed through atmosphere impurities and water vapour causing low temperature in winters.

39. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Longitudes are imaginary semicircles starting from the north pole and ending at the south pole. All longitudes are equal in length irrespective of their location. Latitudes, on the other hand, are imaginary parallel lines which make a circle around the Earth. The equator represents zero-degree Latitude. All parallel circles from the equator to the poles are called parallels of latitudes. As we move away from the equator, the length of latitudes decreases.

Statement 2 is correct: The Earth's **longitude lines run perpendicular to its latitude lines**, forming a grid that helps to identify specific locations on the planet. Latitudes are horizontal lines that measure distance north or south of the equator. Longitudes are vertical lines that measure east or west of the meridian in Greenwich, England. Together, latitude and **longitude enable people to locate points or places on the globe.**

40. Solution: (b)

Exp) Option b is the correct answer.

Assertion (A) is true: It is true that Mars takes about 1.88 times longer to orbit the Sun than Earth.

Reason (R) is true: Mars has a smaller diameter (around 6790 KM) than Earth (around 12800 KM). It has a lower surface gravity, a faster rotation speed on its own axis, and a thinner atmosphere than Earth.

Reason (R) is not the correct explanation of Assertion (A): The diameter of a planet affects its surface gravity, rotation speed (on its own axis), and atmospheric pressure, **but not its orbital period (time taken for a complete revolution around the Sun).** Basically, the orbital period of a planet depends on its distance from the Sun, not on its diameter. The farther a planet is from the Sun, the longer it takes to complete one orbit around the Sun. Mars is about 1.5 times farther from the Sun than Earth, so it takes more time than Earth to orbit around the Sun.

41. Solution: (c)

Exp) Option c is the correct answer.

Atmosphere is **the thin layer of air that surrounds the earth.** It is made up of various gases such as oxygen, nitrogen, carbon dioxide, dust particles and water vapor. The gravitational force of the earth holds the atmosphere around it. It protects us from harmful rays and scorching heat of the sun.

Statement 1 is correct: Sound requires a medium to transmit waves, so if the atmosphere of the earth disappears it would not be possible to hear any sound. One could feel vibrations from the ground, but one **wouldn't hear anything.**

Statement 2 is correct: Birds and planes would fall from the sky in absence of the atmosphere of the earth. Although

we can't see air (except clouds), it has mass that supports flying objects.

Statement 3 is correct: If there was no atmosphere around the earth, its temperature would increase during the day and decrease during the night. In the absence of atmosphere around the earth, the earth will experience extreme temperatures. As the air is a bad conductor of heat, the atmosphere has an average temperature of the earth almost steady during the day and night. It prevents sudden increase in temperature during the daytime. Also, it decreases the rate of escape of heat during nighttime.

42. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct and statement 2 is incorrect: The phenomenon of 'blue moon' occurs when two full moons occur in the same calendar month. It is also known as a monthly Blue Moon. **It happens when there are two full moons in a calendar month, which occurs about once every 2.7 years to 3 years** (not 15 to 20 years). The other definition of a Blue Moon is a seasonal Blue Moon, which is the third full moon in an astronomical season that has four full moons. This happens about once every 2.5 years.

43. Solution: (a)

Exp) Option a is the correct answer.

Statement I is correct: It states that a black hole is an **astronomical entity that cannot be seen by a telescope.** This is true because black holes do not emit any light or other forms of electromagnetic radiation. They are essentially invisible to conventional telescopes.

Statement II is correct: The gravitational field on a black hole is so strong that it does not allow even light to escape. This is also true. According to **Einstein's theory of general relativity, a black hole is formed when a massive star collapses under its own gravity**, creating a region in space where the gravitational pull is so intense that nothing, not even light, can escape from it.

Statement II is the correct explanation for statement I: A black hole cannot be seen through a telescope. The intense gravitational field of a black hole prevents any form of electromagnetic including light radiation from escaping, making it appear completely dark and effectively invisible.

44. Solution: (d)

Exp) Option d is the correct answer.

The pole star also called the North Star indicates the North direction. Therefore, if the person walks keeping the polestar in her right, she will be travelling in the West direction and can reach her home without the help of any instrument to find the direction.

45. Solution: (c)

Exp) Options c is the correct answer.

Statement a is incorrect: Massive celestial bodies formed during the later stages of star formation **refer to protostars, not planetesimals.**

Statement b is incorrect: Large, irregular chunks of rock and ice that orbit in the Kuiper Belt beyond Neptune **refer to Kuiper Belt objects, not planetesimals.**

Statement c is correct: Planetesimals are the building blocks of planets. They are small, solid objects that formed from the dust and gas that remained in the solar system after the Sun's formation. Over time, these planetesimals collided and merged, eventually growing into the planets we see today.

Statement d is incorrect: The remnants of ancient planetary collisions that are now found in the asteroid belt between Mars and Jupiter **refer to asteroids, not planetesimals.**

46. Solution: (d)

Exp) Options d is the correct answer.

Option 1 is correct: Photosynthesis has been instrumental in increasing the oxygen content over geological time scale. **Early Earth had minimal free oxygen until photosynthetic organisms evolved, contributing to the oxygenation of the atmosphere.**

Option 2 is correct: Solar winds are **responsible for stripping away the early, primordial atmosphere of hydrogen and helium from Earth.** This phenomenon affected not only Earth but also other terrestrial planets.

Option 3 is correct: Early Earth's hot atmosphere, rich in hydrogen and helium, lost these light gases to space due to their high energy and weak magnetic field. **This allowed heavier gases like carbon dioxide and nitrogen to accumulate, forming the foundation of today's atmosphere.** This escape of light gases was crucial for life's development, as it created the conditions needed for its existence.

Option 4 is correct: Degassing is the process by which gases trapped within the Earth's interior are released into the atmosphere, often through volcanic activity. **Continuous volcanic eruptions during the Earth's early stages contributed to the outpouring of water vapor and gases,** shaping the composition of the primordial atmosphere.

Important Tips

The evolution of Earth's atmosphere occurred in three stages:

1. **Loss of Primordial Atmosphere:** The early atmosphere, rich in hydrogen and helium, was stripped away by solar winds.
2. **Contribution from Earth's Interior:** During Earth's cooling, gases and water vapor were released from the interior, initiating the evolution of the present atmosphere.
3. **Modification by Living World (Photosynthesis):** Photosynthetic organisms, evolving around 2,500-3,000 million years ago, played a crucial role in altering the atmospheric composition by releasing oxygen into the oceans, eventually flooding the atmosphere around 2,000 million years ago.

47. Solution: (a)

Exp) Option a is the correct answer.

Out of the eight planets, mercury, Venus, earth and mars are called as the inner planets as they lie between the sun and the belt of asteroids the other four planets are called the outer planets. Alternatively, the first four are called Terrestrial, meaning earth-like as they are made up of rock and metals, and have relatively high densities. The rest four are called Jovian or Gas Giant planets. Jovian means Jupiter-like.

Statement 1 is correct: Unlike the spherical shapes of terrestrial planets, the Jovian planets are all slightly oblong. **The Jovian planets rotate much faster than any of the terrestrial planets.** Gravity by itself would make a planet spherical, but their rapid rotation flattens out their spherical shapes by movement of the materials outwards from the equator.

Statement 2 is correct: The solar wind is most intense nearer the sun; so, it blew off lots of gas and dust from the terrestrial planets. The solar winds were not all that intense to cause similar removal of gases from the Jovian planets. The terrestrial planets are smaller and their lower gravity could not hold the escaping gases. Most of Jovian planets are much larger than the terrestrial planets and have thick atmosphere, mostly of helium and hydrogen.

Statement 3 is incorrect: The force of gravity is directly proportional to the mass of the two bodies in question and inversely proportional to the square of their distance. This means that the more massive a body is, the more gravity it has. **The Jovian planets have greater gravitational pull than the terrestrial planets** because of their great masses which result in stronger gravitational fields. And Jovian planets also occupy greater space and hold larger volumes of mass in their surrounding atmospheres.

Important Tips

The terrestrial planets were formed in the close vicinity of the parent star where it was too warm for gases to condense to solid particles. Jovian planets were formed at quite a distant location.

The terrestrial planets are nearly isolated worlds, with only Earth (1 moon) and Mars (2 moons) orbited by any moons at all. In contrast, many moons and rings orbit each of the Jovian planets.

48. Solution: (c)

Exp) Option c is the correct answer.

Origin of the Moon refers to any of the various explanations for the formation of the Moon, Earth's natural satellite.

Statement 1 is correct: In 1838, **Sir George Darwin** suggested that initially, the earth and the moon formed a single rapidly rotating body. The **whole mass became a dumb-bell-shaped body and eventually it broke**. It was also suggested that the **material forming the moon was separated from what we have at present the depression occupied by the Pacific Ocean.**

Statement 2 is incorrect: As per the "**giant impact**" or "the **big splat" theory**, a **body of the size of one to three times that of mars collided into the earth** sometime shortly after the earth was formed. It blasted a large part of the earth into space. This **portion of blasted material then continued to orbit the earth and eventually formed into the present moon** about 4.44 billion years ago.

Statement 3 is correct: The **hypothesis of accretion suggests that the Earth and the Moon formed together as a double system from the primordial accretion disk of the Solar System.** The problem with this hypothesis is that it does not explain the angular momentum of the Earth-Moon system or why the Moon has a relatively small iron core compared to the Earth (25% of its radius compared to 50% for the Earth).

Important Tips

A more radical alternative hypothesis, published in 2010, proposes that the Moon may have been formed from the explosion of a geo-reactor located along the core-mantle boundary at the equatorial plane of the rapidly rotating Earth. This hypothesis could explain the compositional similarities.

49. Solution: (a)

Exp) Option a is the correct answer.

There are three stages in the evolution of the present atmosphere: Solar winds removing primordial gases – Degassing added nitrogen and carbon dioxide – Photosynthesis leading to addition of gases.

Statement 1 is correct: The first stage is marked by the loss of primordial atmosphere. The **early atmosphere, with hydrogen and helium**, is supposed to have been stripped off as a result of the solar winds. This happened not only in case of the earth, but also in all the terrestrial planets, which were supposed to have lost their primordial atmosphere through the impact of solar winds.

Statement 2 is correct: In the second stage, **gases** and **water vapour were released** from the interior solid earth. The process through which the gases were outpoured from the interior is called **degassing**. Continuous volcanic eruptions contributed water vapour and gases to the atmosphere. This led to addition of **water vapour, nitrogen, carbon dioxide, methane, ammonia and very little of free oxygen** to the atmosphere.

Statement 3 is incorrect: In the third stage, the composition of the atmosphere was modified by the living world through the process of photosynthesis. Around 2,500-3,000 million years before the present, the process of **photosynthesis** got evolved. Life was confined to the oceans for a long time. **Oceans began to have the contribution of oxygen through the process of photosynthesis.** Eventually, oceans were saturated with oxygen, and **2,000 million years ago, oxygen began to flood the atmosphere.** The present composition of earth's atmosphere is chiefly contributed by nitrogen and oxygen. First trace of life on land began 408 - 438 million years ago.

Important Tips

As the earth cooled, the water vapour released started getting condensed. The carbon dioxide in the atmosphere got dissolved in rainwater and the temperature further decreased causing more condensation and more rains. The rainwater falling onto the surface got collected in the depressions to give rise to oceans. The earth's oceans were formed within 500 million years from the formation of the earth. This tells us that the oceans are as old as 4,000 million years.

50. Solution: (b)

Exp) Option b is the correct answer.

Meteoroids are objects in space that range in size from dust grains to small asteroids.

Option a is correct: Mesosphere is one of the layers of the atmosphere. It lies above the stratosphere. It extends up to the height of 80 km. **Meteorites burn up in this layer on entering from the space.**

Option b is incorrect: When a **meteoroid survives a trip through the atmosphere and hits the ground**, it's called a **meteorite.**

Option c is correct: Meteor showers is seen when a **stream of dust particles** traveling together through atmosphere burns. We see meteors diverging from a spot in the sky called the radiant of the shower. Many meteor showers recur each year and are associated with particular comets that have left dust behind as they come close to the Sun and their ices evaporate.

Option d is correct: When **meteoroids enter Earth's atmosphere** at high speed and **burn up,** the fireballs is called **"shooting stars" or meteors.** Most meteoroids that enter the Earth's atmosphere are so small that they vaporise completely and never reach the planet's surface.

Important Tips

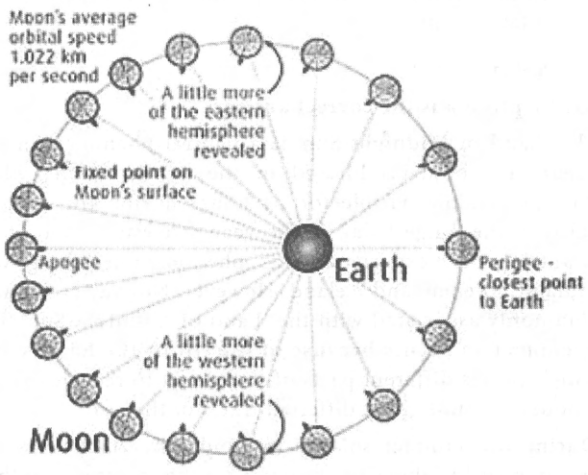
When it comes to counting meteorites, though, Antarctica is an easy target. Most meteorites collected so far have been found on the continent because a single dark rock can be spotted easily enough against a white background.

51. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: The time taken for the Moon to spin on its axis is almost exactly the same as the time it takes to orbit the Earth. The moon moves around the earth in about 27 days. It takes exactly the same time to complete one spin. As a result, **only one side of the moon is visible to us on the earth.** This is not a coincidence. Over billions of years, the Earth's gravity has forced the Moon to spin synchronously with its orbit.

Statement 2 is correct: The same forces that caused the Moon to always show the same face to Earth continue to influence the Moon and Earth today. The Moon still drifts further away a few centimetres a year. The Moon's gravitational force is **slowing down the Earth's rotation** a tiny bit too. If it were not for the Sun's eventual demise, this would continue until the Earth and Moon were 'tidally locked'. In this situation, both the Moon and Earth would spin at the same rate of 47 days, showing the same face to each other for the rest of their existence.



52. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: The pole star as the name suggests, is located directly over the **north pole.** As the earth rotates around its axis, the pole **star unlike other stars in the night sky, does not change its position.** So, the sailors can identify it and thereby find out the North direction.

Statement 2 is correct, but is not the correct explanation of Statement 1.

The North Star, also known as Polaris, is known to stay fixed in our sky. It marks the location of the sky's north pole, the point around which the whole sky turns. We can see the North Star from the Southern Atmosphere, but only in very specific places, at specific times, and if atmospheric conditions are optimal. Typically, this will be around 1.23 degrees south of the equator. The star is, unfortunately, not visible for most locations south of the equator.

In the Southern Hemisphere, we can use **the Southern Cross** – also known as the constellation Crux – to find celestial south.

53. Solution: (a)

Exp) Option a is the correct answer.

Our solar system consists of our star, the Sun, and everything bound to it by gravity – the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune; dwarf planets such as Pluto; dozens of moons; and millions of asteroids, comets, and meteoroids.

Statement 1 is correct: The densest planet in the Solar System is Earth, which has an average density of 5,513 km/m^3 (344 lb/cu ft). The next most dense planet in Mercury, at 5,240 kg/m^3 (327 lb/cu ft).

Statement 2 is incorrect: Venus is often referred to as the 'Earth twin' due to its similar size and proximity to the Sun.

However, Venus has a thick and toxic atmosphere, which makes it the hottest planet in the solar system.

Statement 3 is incorrect: Mars is often called the 'Red Planet' due to its reddish appearance, caused by iron oxide or rust on its surface. It is also known for its volcanoes, valleys, and polar ice caps.

54. Solution: (a)

Exp) Option a is the correct answer.

The 'Land of Midnight Sun' is a natural phenomenon that occurs in countries located in the Arctic Circle, where the sun remains visible for 24 hours during the summer solstice, the longest day of the year. Norway is one of the countries that experience this phenomenon, along with Finland, Sweden, and Iceland. However, Norway is the most commonly associated with the 'Land of Midnight Sun'. This phenomenon occurs **because of the tilt of the Earth's axis**, which causes different parts of the planet to receive varying amounts of sunlight at different times of the year.

During the summer solstice (around June 20-21), the sun remains visible above the horizon for the entire day in these regions, resulting in continuous daylight for up to 24 hours. Conversely, during the winter solstice (around December 21-22), these same regions experience the opposite phenomenon known as polar night, where the sun remains below the horizon for 24 hours or more.

55. Solution: (d)

Exp) Option d is the correct answer.

Sir Sandford Fleming, a Canadian railway engineer, first proposed the concept of Standard Time in 1879. The Prime Meridian, which passes through Greenwich, England, is used as the reference point for calculating Standard Time. Standard Time was established to prevent confusion and improve efficiency in transportation and communication, especially with the growth of railways and telegraphs.

Statement 1 is correct: The division of the world into 24 standard time zones is a well-established convention that is generally followed by most countries. **Each time zone differs from the next by 15 degrees in longitude or one hour in time.** However, due to the unique shapes and locations of some countries, it is not always practical or feasible to adhere strictly to this standard.

Statement 2 is correct: Indian Standard Time is ahead of Greenwich Mean Time by 5 hours and 30 minutes. This is because India is located east of the Prime Meridian.

Statement 3 is correct: A country can have multiple time zones, depending on its size and geographic location. For example, Russia has 11 time zones, while the United States has 6 time zones.

56. Solution: (a)

Exp) option a is the correct option

There are eight planets in our solar system. These can be divided into two groups: the four rocky

planets nearest to the Sun are called Terrestrial Planets, and the four gas giants called Jovian Planets beyond the asteroid belt.

Statement 1 is correct: Terrestrial Planets are comparatively small in size and have relatively higher density compared to Jovian planets. Their atmospheres contain very little hydrogen and helium. Mercury and Mars have solid iron cores, while the solid cores of Venus and Earth contain iron and nickel. On the other hand, the Jovian Planets or the gas giants have deep, often stormy atmospheres. Unlike the rocky planets, these planets do not have solid surfaces, instead, each has a small, rocky core, surrounded by swirling gases and liquids, and is held together by the force of gravity and hence they have lesser density as gases couldn't escape them.

Statement 2 is incorrect: Unlike the spherical shapes of terrestrial planets, the jovian planets are all slightly oblong. The jovian planets rotate much faster than any of the terrestrial planets. Gravity by itself would make a planet spherical, but their rapid rotation flattens out their spherical shapes by flinging material near the equator outward.

Statement 3 is incorrect: Jovian planets are generally larger than the terrestrial planets and have thick atmosphere, mostly of helium and hydrogen. The solar wind was most intense nearer the sun; so, it blew off lots of gas and dust from the terrestrial planets. The solar winds were not all that intense to cause similar removal of gases from the Jovian planets. Also, the terrestrial planets are smaller and their lower gravity could not hold the escaping gases.

57. Solution: (a)

Exp) Option a is the correct answer.

In the course of a year, the earth's revolution round the sun with its axis inclined at 66.5 degree to the plane of the ecliptic changes the apparent altitude of the midday sun.

Statement 1 is correct: The sun is vertically overhead at the equator on two days each year. These are usually 21 march and 21 September, though the dates may change because a year is not exactly 365 days. **These two days are termed as equinoxes** meaning 'equal nights' because on these two days all parts of the world have equal days and nights.

Statement 2 is incorrect: After the March equinox, the sun appears to move north and is vertically overhead of the Tropic of Cancer (Not tropic of Capricorn) on about 21st June. This is known as the June or Northen Hemisphere's Summer Solstice, when the northern hemisphere will have its longest day and the shortest night. When the sun is overhead at the tropic of Capricorn on about 22nd December, it is known as Winter Solstice in the Northen Hemisphere. During this, the southern hemisphere will have the longest day and the shortest night.

Statement 3 is correct: According to Hindu astrology, the Winter Solstice is considered as Tropical Uttarayana. The Sidereal uttarayana begins from Makar Sankranti as the beginning of harvest season where new crops are worshipped and shared.

58. Solution: (c)

Exp) Option c is the correct anwer.

Twilight is a time **between day and night** when there is **light outside**, but the **Sun is below the horizon. Morning twilight** is called **Dawn**, and **evening twilight** is called **Dusk.**

Statements 1, 3 and 4 are correct: Twilight occurs when the **sun rays** fall at angle **below the horizon,** and the light **hits the upper layers** of the **atmosphere.** The atmosphere in turn **reflects and scatter** this light in a diffuse manner onto the lower layers and the Earth surface. For this to happen, the Earth has to **rotate on its axis,** in order for the **sun's rays to hit at different angles** at **different times** to create the phenomenon of day and night. For example, in the mornings and evenings they hit at an angle below the horizon, whereas at midday they are directly above the head. The **tilt of Earth on its axis, intensifies the angle of inclination** of the sun's rays. The **Spherical shape** of the earth also **ensures** that the **sun's rays fall at an angle** on the earth's surface.

Statement 2 is incorrect: Revolution of Earth around Sun is responsible for the **change in seasons**, not for the phenomena of Twilight.

Important Tips

The length of twilight depends on the latitude. Equatorial and tropical regions tend to have shorter During summer months at higher latitudes, there may be no distinction between astronomical twilight after sunset and astronomical twilight before sunrise. This happens when the Sun never goes more than 18 degrees below the horizon during the night.

Similarly, higher latitudes may experience an extended period of nautical or civil twilight.

59. Solution: (d)

Exp) Option d is the correct anwer.

The energy received by the earth's surface in the form of short waves is termed as Incoming Solar Radiation or Insolation.

The axis of Earth is tilted towards the ecliptic of the Sun at an angle of approximately 23.5 degree.

Statement a is incorrect: One **half of the Earth being too hot with continuous insolation**, while one half would be **frozen due to no insolation** will occur only if the **earth stoppcd rotating on its axis (not bccausc of lack of tiltcd axis)**. If the earth **stopped rotating**, there would be **no day and night** for all places on earth. Then one half of the earth will continuously face the sun, and one half will be in perpetual darkness.

Statement b is incorrect: All the **places on different latitudes** will **receive the same amount of insolation** only when the **earth is flat and no longer spherical in shape (not because of lack of tilt** of the axis). As long as the **earth is spherical** in shape, the sun **rays will have to travel varying lengths** to reach them and the **level of their directness** and **concentration upon unit area will vary,** leading to **uneven distribution of insolation.**

The tilt of the axis only enhances the slant of the sun rays with an increase in latitude, so **only the intensity of difference in insolation** will **change** if the earth is no longer tilted.

Statement c is incorrect: Hot places becoming **cold due to reduced insolation and vice versa** will **never happen** as places in a more direct path to sun's rays will always receive more insolation and will always be hotter than places on higher latitude.

Statement d is correct: The **main effect** of the **tilt of earth on its axis,** as it **moves along its orbit** around the sun, is that it **brings one half of the earth marginally closer to the sun** for **half the year** and makes one half marginally farther from the sun for half the year. This causes the **temperatures to change seasonally in a place. Days are longer**, there is **more insolation** and **temperatures are hotter** in the half tilted towards the sun and vice versa.

60. Solution: (b)

Exp) Option b is the correct anwer.

Mercury, Venus, Earth and Mars are called as the **inner planets of the Solar System** as they lie between sun and the belt of the asteroids. They are also called as **Terrestrial Planets** (earth like). The rest four are called as **Jovian** or **Gas Giant planets. Jovian means Jupiter like.**

Statement 1 is incorrect: Mars is **tilted** at an angle of almost **25 degrees**. This leads to the **phenomenon of seasons** as it completes its revolution around the Sun.

On the other hand, **Venus** has a **tilt of barely 2 or 3 degrees**, so it **does not experience seasons**.

Statement 2 is correct: Venus has an **atmosphcrc dominatcd** by **carbon dioxide** as well as **sulphuric clouds**, which **traps all the heat** received from the sun. This leads to **very hot temperatures (around 450 degrees celsius)** as well as very **high pressures** (as much as **90 times that on Earth**) on Venus.

Important Tips

Venus' s weather:

- All the planetary water has escaped due to the heat, so there is no rain or storms.
- Lightning has been detected.
- Slow rotation speed and greenhouse gas effect cause almost uniform temperatures in both day and night (almost minimal diurnal temperature range).
- The hottest planet in solar system (even more than Mercury - the planet closest to the Sun)

Mars's weather:

- The Martian atmosphere is composed mainly of Carbon Dioxide.
- Unlike Venus, the Martian atmosphere is very thin, so the heat easily escapes, leading to cooler temperatures than the Earth.
- Windstorms of red dust are very common on the planet.
- There's no flowing water, but enough water vapour exists in the atmosphere, to lead to the formation of thin wispy clouds. However there is no precipitation.

61. Solution: (d)

Exp) Option d is the correct anwer.

When the solar system settled into its current layout about 4.5 billion years ago, Earth formed when gravity pulled swirling gas and dust in to become the third planet from the Sun.

Earth is one of the four inner, terrestrial planets in our solar system. Just like the other inner planets—Mercury, Venus, and Mars—it is relatively small and rocky. Early in the history of the solar system, rocky material was the only substance that could exist so close to the Sun and withstand its heat.

Statement 1 is correct. Earth's early atmosphere was most likely composed of **hydrogen and helium.** The early atmosphere is supposed to have been **stripped off as a result of the solar winds.** This happened not only in case of the earth, but also in all the terrestrial planets, which were supposed to have lost their primordial atmosphere through the impact of solar winds.

Statement 2 is correct. As the planet changed, and the crust began to form, volcanic eruptions occurred frequently. **These continuous volcanic eruptions pumped water vapour, ammonia, and carbon dioxide** into the atmosphere around Earth. As the earth cooled, the water vapour released started getting condensed. The carbon dioxide in the atmosphere got dissolved in rainwater and the temperature further decreased causing more condensation and more rains.

Statement 3 is correct. The rainwater falling onto the surface got collected in the depressions to give rise to oceans. Around 2.2 billion to 2.7 billion years before the present, the process of photosynthesis got evolved and primitive life began in those oceans. Tiny organisms known as **cyanobacteria, or blue-green algae later contributed oxygen** into the atmosphere.

Statement 4 is correct. At its beginning, Earth was extremely hot, to the point that the planet likely consisted almost **entirely of molten magma.** Over the course of a few hundred million years, the planet began to cool and oceans of liquid water formed. Heavy elements began sinking past the oceans and magma toward the centre of the planet. As this occurred, Earth became differentiated into layers, with the **outermost layer being a solid** covering of relatively lighter material while the **denser, molten material sunk to the centre.**

62. Solution: (a)

Exp) Option a is the correct anwer.

Albedo is the fraction of light that is reflected by a body or surface. It describes the reflective properties of planets, satellites, and asteroids.

Statement 1 is correct. Albedo is a non-dimensional, unitless quantity **that indicates how well a surface reflects solar energy.** The albedo of an object will determine its visual brightness when viewed with reflected light. For example, the **planets are viewed by reflected sunlight and their brightness depends upon the amount of light received from the sun** and their albedo. When an object reflects most of the light that hits it and looks bright then it has high albedo.

Statement 2 is incorrect. Mercury receives the maximum amount of sunlight, but its **albedo is only 0.1** so it is not as bright as it would be with a higher albedo. The albedo of the **Earth is 0.37**. Therefore, Albedo of Earth is greater than Mercury.

Planet	Mercury	Venus	Earth	Moon	Mars	Pluto
Geometric Albedo	0.138	0.84	0.367	0.113	0.15	0.44-0.61
Bond Albedo	0.119	0.75	0.29	0.123	0.16	0.4

Planet	Jupiter	Saturn	Uranus	Neptune
Bond Albedo	0.343 +/-0.032	0.342+/-0.030	0.290+/-0.051	0.31+/-0.04

63. Solution: (d)

Exp) Option d is the correct anwer.

At about 864,000 miles (1.4 million kilometres) wide, the sun is 109 times wider than Earth, and it accounts for more than 99.8 percent of the solar system's total mass.

Statement 1 is correct. The sun was formed more than 4.5 billion years ago when a **cloud of dust and gas called a nebula collapsed under its own gravity**. As it did, the cloud spun and flattened into a disk, with sun forming at its centre. The disk's outskirts later accreted into our solar system, including Earth and the other planets.

Statement 2 is correct. Deep in the sun's core, **nuclear fusion converts hydrogen to helium,** which generates energy. **Particles of light called photons** carry this energy to the top layer of the solar interior, the convection zone. There, hot plasmas rise and fall, which transfers energy to the sun's surface, called the **photosphere.**

Statement 3 is correct. The steady stream of charged particles that is radiated by the sun in addition to light and heat are known as the **solar wind.** The wind blows about 280 miles (450 kilometres) a second throughout the solar system, extending the sun's magnetic field out more than 10 billion miles. Beyond that distance, the solar wind gives way to the colder, dense material that drifts in between stars, forming a boundary called the **heliopause.**

Statement 4 is correct. Solar flares are large eruptions of electromagnetic radiation from the Sun lasting from minutes to hours. It is a tremendous explosion on the Sun that happens when energy stored in 'twisted' magnetic fields (usually above sunspots) is suddenly released.

They heat material to many millions of degrees and produce a burst of radiation across the electromagnetic spectrum, including from radio waves to x-rays and gamma rays.

Important Tips

- The sun's surface temperature is about 10,000 degrees Fahrenheit (5,500 degrees Celsius), and it's 27 million degrees Fahrenheit (15.5 million Celsius) at the core.
- Sun is filled with scorching gases and soups of electrically charged particles called plasma.
- Sun is a powerful center of attention- holds the solar system together; provides life-giving light, heat, and energy to Earth; and generates space weather.

64. Solution: (d)

Exp) Option d is the correct answer.

The Orion Arm is **the minor spiral arm of the Milky Way Galaxy** and is probably some 3,500 light-years wide. The **Solar System (including the Earth and the Sun) is located in the Orion Arm** - about one-third from the centre (26,000 light years from the centre) of the Milky Way galaxy.

Our Milky Way galaxy is the island of stars. Our solar system lies between two prominent spiral arms, in what astronomers once thought was a mere bridge of stars, gas, and dust clouds. In recent decades, research advances have revealed that we live in our very own spiral arm of the galaxy, albeit a relatively minor one. Our spiral arm is the Orion-Cygnus Arm, or simply, the Orion Arm or Local Arm.

The Orion Arm gets its name from the constellation Orion the Hunter, which is one of the most prominent constellations of Northern Hemisphere winter (Southern Hemisphere summer).

65. Solution: (b)

Exp) Option b is the correct answer.

The Earth has a rather slight equatorial bulge: it is about 43 km (27 mi) wider at the equator than pole-to-pole. The bulging of the equator and flattening at the poles is **due to the rotation of the Earth** which **creates the centrifugal force.** Centrifugal force increases as one moves from poles towards the equator and is therefore greater at the equator. This increase in centrifugal force has led to pole fleeing. As a result, a person on the equator is over 13 miles farther from Earth's center than a person on the North Pole is. That difference is more than double the distance between sea level and the top of Mount Everest, but on a planetary scale, this bulge is virtually imperceptible. Centrifugal force is the **force which is perpendicular to the axis of the Earth** on excluding the equator.

66. Solution: (d)

Exp) Option d is the correct anwer.

The equator is an imaginary line of latitude on the spheroid (Earth), dividing it into southern and northern hemispheres. On earth, this line is approximately 24,901 miles of which only 21.3% lies on land and the rest on the water. The Equator runs through several countries, mainly in Africa and South America. However, Indonesia (Southeast Asia) is straddled the most by the equator.

Singapore is around one-and-a-half degrees north of the equator, lying entirely between the 1st and 2nd parallels. It is nearest to the equator among the above given cities.

Jakarta is the capital of Indonesia. Lying on the northwest coast of Java (the world's most populous island), its Coordinates are 6°12'S 106°49'E.

Colombo is the capital of Sri Lanka by population. Its Coordinates: 6°56'04'N 79°50'34'E.

Manila, is the capital of the Philippines, and its coordinates are 14°36'N 120°59'E.

67. Solution: (d)

Exp) Option d is the correct answer.

A Black hole is a cosmic body of extremely intense gravity.

Statement 1 is correct. Black holes are created when a massive star reaches the end of its life and implodes, **collapsing in on itself.** It is formed by the collapse of individual stars that are relatively small, but incredibly dense. A black hole **takes up zero space,** but does have mass — originally, most of the mass that used to be a star.

Statement 2 is correct. According to Einstein's general theory of relativity, the **gravity of a black hole is so intense that nothing can escape** it – not **even light cannot get out.** The gravity is so strong because matter has been squeezed into a tiny space and is extremely dense. They get "bigger" as they consume matter near them. The bigger they are, the larger a zone of "no return" they have, where anything entering their territory is irrevocably lost to the black hole. This **point of no return is called the event horizon.**

Statement 3 is correct. No black hole is present in the or is close to the Solar system for the Earth and therefore Earth will not fall into a black hole. The newly discovered black hole is about 1,011 light-years from our solar system in the star system HR 6819.

Besides, black holes do not go around the Universe swallowing stars and planets. Suppose a black hole were to take the place of the Sun. The black hole would have the same gravity as the sun. Earth would still not fall into it and would orbit the black hole as it would orbit the Sun.

68. Solution: (d)

Exp) Option d is the correct anwer.

Assertion is false. As far as we can tell, there is no edge to the universe. Space spreads out infinitely in all directions. Furthermore, galaxies fill all of the space through-out the entire infinite universe. Since **universe is technically expanding faster than the speed of light** as the space between galaxies is also expanding. It drives the edge of the universe further and further from us every single second. Therefore, it is theoretically **impossible to ever reach the "edge"** of the universe, since it will always be moving away faster than we could ever move towards it.

Reason is false.

Astronomers have found that whole clusters of galaxies are moving in convoy towards a single point in the sky. This unexpected motion appears to be separate from the expansion of the universe and the researchers even suggest that a force beyond the visible universe is the reason. The discovery has been named "dark flow".

Cosmologists have observed two distinct effects caused by invisible entities in the universe: dark matter is known to affect the rotation of galaxies and **dark energy seems to be causing the expansion of the universe to accelerate.** In simple terms, the space between galaxies is also expanding, which drives the edge of the universe further and further.

69. Solution: (b)

Exp) Option b is the correct anwer.

Carbon, Hydrogen, Nitrogen were primarily responsible for the origin of life on the Earth.

Hydrogen, Nitrogen, Oxygen, Phosphorus and Sulfur combined with Carbon generated the first group of compounds that eventually formed the chemical basis of life.

The matter within every living Earth creature mainly consists of just four chemical elements: hydrogen, oxygen, carbon, and nitrogen.

70. Solution: (b)

Exp) Option b is the correct anwer.

Jupiter and Saturn lie between Mars and Uranus.

The **International Astronomical Union** defines a true planet as a body that circles the sun without being some other object's satellite; is large enough to be rounded by its own gravity (but not so big that it begins to undergo nuclear fusion, like a star); and has "cleared its neighbourhood" of most other orbiting bodies.

The order of the planets in the solar system, starting nearest the sun and working outward is the following: **Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune.**

71. Solution: (b)

Exp) Option b is the correct anwer.

Nebulae are clouds of gas and dust which form in interstellar space. They range in size from millions of miles across to hundreds of light years across. Nebulas are **mostly composed of hydrogen along with smaller amounts of other gases and dust particles.** Stars and planetary systems are formed from the gas and dust within nebulae under their own weight through fusion. Like humans, stars are also born at a certain time and place, and their birthplaces are what astronomers call nebulae or **star nurseries**.

Planetary Nebula form when **a star runs out of fuel to burn**. The star blows off its layers of gas in the shape of a ring or bubble. It is a type of nebula. They are made of gas and plasma.

Pulsar- It is a rotating neutron star, that is highly magnetized and it emits a beam of electromagnetic radiation.

Quasar- It stands for quasi-stellar object and that refers to any of the celestial objects that are similar to a star in appearance but has a comparatively high redshift.

72. Solution: (c)

Exp) Option c is the correct anwer.

The outer planets are Jupiter, Saturn, Uranus, and Neptune. These gas giants are made up primarily of hydrogen and helium, the same elements that make up most of the Sun. The inner planets, or terrestrial planets, are the four planets closest to the Sun: Mercury, Venus, Earth, and Mars.

Statement a is incorrect. Inner planets have lower gravity as compared to Outer planets. So higher gravity can hold the escaping gases much stronger as compared to Inner planets.

Statement b is incorrect. The presence of rings does not decide the gaseous nature of planets. In fact, all four Outer planets have rings, although only Saturn's rings are easily visible from Earth. Rings are composed of countless **small pieces of rock and ice**, each orbiting its planet like a tiny moon.

Statement c is correct. As a result of their enormous gravity, Outer planets captured a large amount of hydrogen and other gasses from the surrounding nebula and thus these are gaseous in nature.

Statement d is incorrect. The cores of all four Outer planets or all inner planets are made of some combination of **rock, metal and hydrogen compounds**. The deeper you go, the hotter and denser it gets. An increase in temperature and density means an increase in pressure. Thus, these are not the deciding factors for the gaseous nature of outer planets.

73. Solution: (d)

Exp) Option d is the correct anwer.

The Moon is Earth's only natural satellite and the fifth largest moon in the solar system. The Moon's presence helps stabilize our planet's wobble and moderate our climate. The Moon's distance from Earth is about 240,000 miles (385,000km).

Statement 1 is incorrect. Recent studies confirm that our moon does indeed have an atmosphere consisting of some unusual gases, including sodium and potassium, which are not found in the atmospheres of Earth, Mars or Venus. It's an infinitesimal amount of air when compared to Earth's atmosphere.

Statement 2 is incorrect. As Moon **has very thin atmosphere, meteoroids can easily strike its surface** as nothing is obstructing its path. As a result, tiny craters are quite common on lunar rocks.

However almost all the meteoritic material is vapourised in Earth's atmosphere, leaving a bright trail fondly called "shooting stars."

Statement 3 is incorrect. Impact crater on the lunar surface is mainly due to the attacking of its surface by meteors and not due to plate tectonics. **Plate tectonics is absent on the Moon.** The mass of the Moon is probably too small for this to occur. The Moon's Mantle, too cool to move easily, has no convection and no active tectonic plate motions, due the Moon's smaller size and cooler interior than Earth.

74. Solution: (c)

Exp) Option c is the correct anwer.

Statement a is correct. The goldilocks zone **is the distance that a planet must be from its star in order to support liquid water.** If a planet is too close to its sun, it will be too hot – the water will evaporate. If it's too far, it will be too cold, and the planet will freeze. Earth, as it just so happens, lies in that goldilocks zone where water can exist in its liquid state. A planet's location in this habitable zone plays a big role in what the planet will look like – whether that is a dry, desert-like planet, or a humid ice planet.

Statement b is correct. Unlike Venus or Mars, the **Earth has an active plate tectonic system**, which continuously produces and destroys the crust. The same system also gives

us active water, oxygen and carbon dioxide cycles, as material is subducted down into the Earth's interior, and eventually re-erupted from volcanoes. However, while tectonics give the Earth active water and gas cycles, the tectonic system itself moves too slowly to be the process that actively maintains the climate.

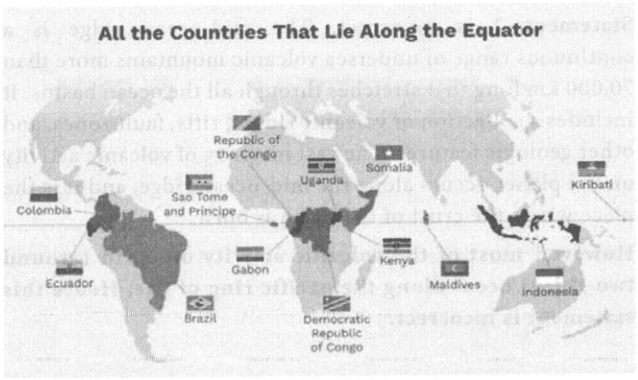
Statement c is incorrect. The **high-mass stars emit too much ultraviolet radiation. The lifetime** of a high-mass star is **too short**. High-mass stars live only a few million years, and life probably cannot arise until a planet is at least a couple hundred million years old. Smaller stars like the Sun survive far longer than do high-mass stars. Thus, it is not a reason for habitable nature of earth.

Statement d is correct. Earth has a molten core, which is responsible for producing our Earth's magnetosphere. Our **magnetosphere** protects us from the sun's harmful rays that otherwise would spell disaster for any life on Earth. Because of this, Earth's magnetic field played a vital part in making Earth a habitable planet.

75. Solution: (b)

Exp) Option b is the correct anwer.

The equator is an imaginary line that circles the Earth, splitting it into the Northern and Southern hemispheres. Because of this, the intersection point of any location by the equator is equidistant from the North and South poles. Find out what life is like for countries along the equator. Although the equator stretches 40,075 kilometres around the world, it travels through just **13 countries**, though only the water controlled by two of these rather than the landmasses themselves.



The Equator passes through 13 countries: Ecuador, **Colombia,** Brazil, Sao Tome & Principe, Gabon, Republic of the Congo, Democratic Republic of the Congo, Uganda, **Kenya**, Somalia, Maldives, **Indonesia** and Kiribati. At least half of these countries rank among the poorest in the world.

76. Solution: (c)

Exp) Option c is the correct anwer.

"Land area" refers to the total surface area of the land of a geographical region or country (which may include discontinuous sections of land such as islands).

Statement 1 is correct. Earth's total planimetric (flat) land area is approximately 147,539,063.133 km2 (57,505,693.767 sq mi) **which is about 29.2% of its total surface**, including that which is covered by ice. Water covers approximately 70.8% of planimetric Earth's surface, mainly in the form of oceans and ice formations; but this proportion is decreased by the land's increased terrain.

Statement 2 is correct. Pacific Ocean is the **largest water mass on the planet**. It covers more than 30 percent of the Earth's surface. With a surface area of more than 155 million square kilometres (60 million square miles), this ocean basin is **larger than the landmass of all the continents combined**. Additionally, it contains almost twice as much water as the world's second largest body of water, the Atlantic Ocean.

77. Solution: (c)

Exp) Option c is the correct anwer.

The Sun and its family of planets formed when a cloud of dust and gas condensed 4.6 billion years ago. Several hundred million years after the Earth took form, an outer crust developed.

From the outset, heat and gravity shaped the evolution of the planet.

Statement 1 is correct. The materials that accreted into the early Earth were probably added piecemeal, without any particular order (though some models call on sequential accretion of metallic and then silicate materials). The early Earth was very hot from **gravitational compression and Radioactive decay (much more than today).**

The early Earth was probably partially or largely molten. The denser metallic liquids sank to the centre of the Earth and less dense silicate liquids rose to the top. In this way the Earth very quickly differentiated into a metallic, mostly iron core and a rocky silicate mantle.

Statement 2 is correct. It is believed that during the early formation of Earth, asteroids were continuously bombarding the planet, and could have been carrying with them an important source of water. Scientists believe the **asteroids that slammed into Earth contained a significant amount of water in their minerals.**

Some suggest that nearly 30 per cent of the water contained initially in the asteroids would have remained in the fragmented sections of rock on Earth, even after impact.

78. Solution: (b)

Exp) Option b is the correct anwer.

The correct sequence of the given Continents in the decreasing order of their percentage of Earth's land are **Africa – North America – South America – Europe.**

1. **Asia:** It is a landmass variously described as part of Eurasia or as Earth's largest and most populous continent in its own right, located primarily in the Eastern and Northern Hemispheres. It shares the continental landmass of Eurasia with the continent of Europe and the continental landmass of Afro-Eurasia with both Europe and Africa. Asia covers an area of 44,579,000 square kilometres (17,212,000 sq mi), about 30% of Earth's total land area and 8.7% of the Earth's total surface area.

2. **Africa** is the world's second-largest and second-most populous continent, after Asia in both cases. At about 30.3 million km2 (11.7 million square miles) including adjacent islands, it covers 6% of Earth's total surface area and 20% of its land area.
3. **North America** is a continent in the Northern Hemisphere and almost entirely within the Western Hemisphere. It can also be described as the northern subcontinent of a single continent, America. North America covers an area of about 24,709,000 square kilometres (9,540,000 square miles), about 16.5% of the Earth's land area and about 4.8% of its total surface. North America is the third-largest continent by area, following Asia and Africa, and the fourth by population after Asia, Africa, and Europe.
4. **South America** is a continent entirely in the Western Hemisphere and mostly in the Southern Hemisphere, with a relatively small portion in the Northern Hemisphere.
5. **Antarctica is** Earth's southernmost continent. It contains the geographic South Pole and is situated in the Antarctic region of the Southern Hemisphere, almost entirely south of the Antarctic Circle, and is surrounded by the Southern Ocean. At 14,200,000 square kilometres (5,500,000 square miles), it is the fifth-largest continent and nearly twice the size of Australia.
6. **Europe** is a landmass variously recognised as part of Eurasia or a continent in its own right, located entirely in the Northern Hemisphere and mostly in the Eastern Hemisphere. Europe covers about 10.18 million km2 (3.93 million sq mi), or 2% of the Earth's surface (6.8% of land area), making it the second-smallest continent.
7. **Australia** is a sovereign country comprising the mainland of the Australian continent, the island of Tasmania, and numerous smaller islands.[13] It is the largest country by area in Oceania and the world's sixth-largest country. Australia's population of nearly 26 million, in an area of 7,617,930 square kilometres.

79. Solution: (d)

Exp) Option d is the correct anwer.

The correct chronological sequence of the above events is -

1. It is the process of Differentiation through which earth forming material got separated into different layers, like Crust, Mantle, Outer Core and Inner Core.
2. Then started the formation of atmosphere in which the first stage is marked by the loss of Primordial atmosphere i.e., loss of hydrogen and helium present in early atmosphere by solar winds.
3. This was followed by the Process of Degassing, in which the gases were outpoured from the interior of earth. The early atmosphere largely consisted of water vapour, nitrogen, carbon dioxide, methane, ammonia and very little of oxygen. Continuous volcanic eruptions contributed water vapour and gases.
4. As the earth cooled, the water vapour released started getting condensed. The carbon dioxide in the atmosphere got dissolved in rainwater and the temperature further got decreased causing more condensation and more rains. The rainwater falling onto the surface got collected into the depressions and gave rise to oceans. **And then life began to evolve along with the process of photosynthesis.**

80. Solution: (a)

Exp) Option a is the correct anwer.

Volcanism is the eruption of molten rock (magma) onto the surface of a planet.

Statement 1 is correct. Planetary scientists have found evidence of volcanism on every terrestrial planet and on many of the moons and even some asteroids. While the Moon and Mercury have relatively small volcanoes, those on Venus, Earth and Mars are large and numerous.

Statement 2 is incorrect. The mid-ocean ridge is a continuous range of undersea volcanic mountains more than 70,000 km long that stretches through all the ocean basins. It includes a collection of volcanic ridges, rifts, fault zones, and other geologic features. The vast majority of volcanic activity on the planet occurs along the mid-ocean ridge, and it is the place where the crust of the Earth is born.

However, most of the volcanic activity on earth (around two-third) occur along the pacific ring of fire. Hence this statement is incorrect.

GENERAL GEOGRAPHY

GEOMORPHOLOGY

2.1. Earth's Interior and Structure

1. In the context of Earth's interior, consider the following statements about the Barysphere.

1. Olivine is the primary component of the Barysphere.
2. Owing to extremely high temperature and pressure, this entire region exists in the liquid state.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

2. Consider the following statements regarding the Geysers:

1. They are vent in Earth's surface that periodically ejects hot water and steam.
2. They are very common and can be found evenly in every region of the world.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

3. With reference to the interior of the Earth, consider the following statements:

1. Generally as we go deeper into the mantle, the speed of seismic waves increases.
2. The disappearance of P waves in the outer core signifies that it is in liquid state.
3. There is complete disappearance of S waves when passing through the asthenosphere.
4. Sudden jumps in seismic velocities across a boundary denotes the presence of discontinuity in earth's interior.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 4 only
(d) 3 and 4 only

4. Which of the following is incorrect in regard to the discontinuities in the interior of the Earth?

(a) The Conrad discontinuity is not found in oceanic regions.
(b) There is no change in the velocity of P waves while passing through the Mohorovicic discontinuity.
(c) Lehmann discontinuity is the transition zone between outer and inner core.
(d) Repetti discontinuity is the transition zone present within the mantle layer.

5. With reference to the interior of Earth, consider the following statements:

1. Gneiss characterizes the continental crust while the gabbro characterizes the oceanic crust.
2. The asthenosphere is more ductile than the lithosphere but lesser ductile than the lower mantle.
3. The Earth's magnetic field originates due to the eddy currents formed in the outer core.
4. The inner core is composed primarily of iron and nickel.

Which of the statements given above are correct?

(a) 1,2 and 3 only
(b) 2,3 and 4 only
(c) 1,3 and 4 only
(d) 1,2,3 and 4

6. With respect to 'Earth's Interior', consider the following pairs:

Discontinuities	Transition Zone
1. Conrad	Between the Crust and Mantle.
2. Gutenberg	Between Mantle and Core.
3. Lehman	Between Outer Mantle and Inner Mantle.
4. Mohorovicic	Between Upper and Lower Crust

How many pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

7. Consider the following elements of earth's crust:

1. Silicon
2. Oxygen
3. Calcium
4. Aluminium
5. Sodium
6. Iron

Arrange the above elements in descending order according to their weight (%) in the earth's crust:

(a) 2-1-4-6-5-3
(b) 2-1-3-4-6-5
(c) 1-2-4-3-5-6
(d) 2-1-4-6-3-5

8. Consider the following sources of information about the interiors of the Earth:

1. Gravitational force
2. Surface rocks
3. Meteors
4. Seismic activity
5. Earth's magnetic field

How many of the above are 'indirect sources' of information regarding the Earth's interior?

(a) Only two
(b) Only three
(c) Only four
(d) All five

9. The structure of the Earth can be broadly classified into the crust, mantle, and core. In this context, consider the following statements:

1. The 'crust' is the densest of all the layers of the Earth.
2. The 'mantle' comprises more than two-thirds of the Earth's volume.
3. The 'core' of the Earth is composed entirely of solid iron.

Which of the statements given above is/are correct?

(a) 2 only
(b) 2 and 3 only
(c) 1 only
(d) 1 and 2 only

10. Consider the following discontinuities:

1. Lehman Discontinuity
2. Conrad Discontinuity
3. Repetti Discontinuity
4. Mohorovicic Discontinuity

What is the correct order of the above discontinuities as they occur from Crust to Core of Earth?

(a) 2-4-3-1
(b) 4-2-1-3
(c) 2-3-1-4
(d) 4-1-2-3

11. Which of the following statements best describes the term, 'Vadose Zone'?

(a) The layer of soil and rock that is excessively saturated with water pollutants.
(b) The zone of saturation of the groundwater in the aquifer.
(c) The Earth's terrestrial subsurface extending from surface to the regional groundwater table.
(d) The area beneath the Earth where an aquifer has been depleted due to groundwater extraction.

12. Consider the following statements regarding the inner core of the Earth:

1. It is primarily composed of iron and nickel.
2. It makes up around 50 percent of the Earth's mass.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

13. Consider the following:

1. Mines
2. Meteors
3. Gravitational force
4. Volcanic eruption
5. Seismic waves

Which of the above are the direct sources of information about the Earth's interior?

(a) 4 only
(b) 1 and 4 only
(c) 1, 2 and 5 only
(d) 1, 2, 3, 4 and 5

14. With reference to interior of the Earth, consider the following statements:

Statement I: The density of oceanic crust is higher than the density of continental crust.

Statement II: Oceanic crust is primarily composed of granite rock, whereas continental crust is predominantly made of basalt rock.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation for Statement I.
(b) Both Statement I and Statement II are correct and Statement II is not the correct explanation for Statement I.
(c) Statement I is correct, but Statement II is incorrect.
(d) Statement I is incorrect, but Statement II is correct.

15. The Earth is divided into three different layers namely crust, mantle, and core. With reference to this 'Core' of the Earth, consider the following statements:

1. It is primarily composed of iron and nickel.
2. The Earth's inner core generally rotates at a different speed as compared to the rest of the Earth.
3. It is the main source of magma that emerges onto Earth's surface during volcanic eruptions.
4. Earth's magnetic field is generated due to the movement of liquid materials in Earth's Core.

Which of the statements given above is/are correct?

(a) 1 and 4 only
(b) 2 and 3 only
(c) 1 only
(d) 1, 2 and 4

16. The Mohorovicic Discontinuity marks the boundary between which of the following layers of the Earth?

(a) Crust and upper mantle
(b) Upper mantle and lower mantle
(c) Lower Mantle and outer core
(d) Outer core and inner core

17. Consider the following statements with reference to earth's crust formation:

1. The oceanic crust originates from the Mid-oceanic Ridges and spreads towards the continents.
2. Outgassing refers to release of previously dissolved, trapped and frozen gas along the mid-ocean ridge.

Which of the statements given above is/are ***incorrect***?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 Nor 2

18. Consider the following statements:

1. The axis of the Earth's magnetic field is inclined at 23 ½° to the geographic axis of the earth.
2. The Earth's magnetic pole in the northern hemisphere is located on a peninsula in northern Canada.
3. Earth's magnetic equator passes through Thumba in South India.

Which of the statements given above is/are correct?

(a) 1, 2 and 3
(b) 2 and 3 only
(c) 2 only
(d) 3 only

19. In context of plate tectonics theory, which among the following landform feature(s) is/ are present along a subduction zone?

1. Deep ocean trench
2. Forearc basin
3. Chain of volcanic island arcs
4. Accretionary wedges

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 1, 3 and 4 only
(c) 3 and 4 only
(d) 1, 2, 3, and 4

2.2. Volcanism and Earthquakes

20. In the context of volcanic eruptions, which of the following statements is/are correct?

1. Shield Volcanoes are characterized by highly fluid basaltic lava flows.
2. Composite volcanoes are characterized by explosive eruptions.

Select the correct answer using the code given below:

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

21. Which of the following places fall within the Pacific Ring of Fire?

1. Indonesia
2. Mount Fuji
3. Papua New Guinea
4. Bolivia

Select the correct answer using the codes given below:

(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

22. Which of the following is *incorrect* regarding the magnitude of an earthquake?

(a) It is the measure of the energy released at the source of the earthquake.
(b) It does not depend on the location where measurement is made.
(c) The Richter scale measures the magnitude of earthquakes.
(d) It is the only parameter to determine how strongly the earthquake impacts a specific location.

23. Consider the following statements about the volcanic mountains:

1. They can only occur near divergent boundaries of tectonic plates.
2. Composite volcanic mountains are the smallest type of volcanic mountains on the Earth.
3. Mt. Merapi, a type of volcanic mountain, is located in Indonesia.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 3 only.

24. Which one of the following region(s) experiences "intraplate *seismicity*"?

1. Narmada-Son region
2. Rann of Kutch
3. Latur region

Select the correct answer using the code given below:

(a) 3 only
(b) 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

25. Consider the following statements:

1. P-Waves create troughs and crests in the material through which they pass.
2. S-Waves can travel only through solid materials in Earth's crust.
3. The shadow zone of the S-wave is much larger than that of the P-waves.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

26. Consider the following statements with reference to *"Mantle Plumes"*:

1. They are the cause of volcanic hotspots.
2. They are a secondary way through which the earth loses heat.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

27. Consider the following statements regarding the Surface Earthquake Waves:

1. They are generated by the interaction of body waves with surface rocks.
2. Their speed is slower than Body waves.
3. They are usually more destructive than Body waves.
4. As compared to Deeper Earthquakes, Shallow Earthquakes produce stronger Surface Waves.

Which of the statements given above are correct?

(a) 1, 2 and 3 only
(b) 1, 2 and 4 only
(c) 2, 3 and 4 only
(d) 1, 2, 3 and 4

28. Which of the following statements are correct regarding 'Crater'?

1. Impact Crater is a large depression mostly formed due to the collision of a meteorite with the Earth's surface.
2. Craters are usually smaller than calderas.
3. Lonar Crater Lake was created by the impact of an extra-terrestrial body.

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

29. Which of the following statements is/ are correct regarding the distribution of volcanoes and earthquakes around the world?

1. Volcanoes are located closely to regions that have been intensely folded or faulted.
2. In the central parts of the Atlantic Ocean, volcanoes are found almost parallel to the coastlines.
3. The Indian Ocean has been estimated to have around two-thirds of the world's volcanoes.

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 1 only
(c) 2 and 3 only
(d) 1, 2 and 3

30. With reference to the Pelean Eruptions, consider the following statements:

1. They are characterized by the formation of Lava Domes.
2. They are not particularly dangerous or destructive.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

31. Which among the following can be considered as Active Volcanoes?

1. Barren Island
2. Mount Mauna Loa
3. Mount Kilimanjaro
4. Mount Mauna Kea
5. Mount Etna

Select the correct answer using the code given below:

(a) 1, 2 and 5 only
(b) 1, 3 and 4 only
(c) 2, 4 and 5 only
(d) 2, 3 and 4 only

32. In the context of volcanic eruption, "Lahar" is the:

(a) molten rock that flows out of a volcano
(b) hot or cold mixture of water and rock fragments
(c) mixture of pulverised rock, ash and hot gases
(d) volcanic fallout consisting of fragmented rocks

33. Consider the following statements with reference to Earthquakes:

1. The point within the Earth from where the energy is released is called the Epicentre of an earthquake.
2. Focus is the point at the surface which is directly above the Epicentre.
3. During Earthquake, the energy is released and travels in the form of seismic waves.

Which of the above given statements is/are correct?

(a) 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

34. Consider the following statements with reference to the distribution of the Earthquakes in the world:

1. Earth's major earthquakes occur mostly in regions coinciding with the margins of tectonic plates.
2. The seismic activity is uniform throughout the Circum-Pacific Belt where most earthquakes occur.
3. Alpine-Himalayan belt is the region of occurrence of more than half of the Earthquakes of the world.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 only
(c) 2 and 3 only
(d) 1 and 3 only

35. Which among the following can be considered as the impact of the earthquake in a region?

1. Tsunamis
2. Landslides
3. Fires
4. Soil liquefaction

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 1 and 4 only
(c) 2 and 4 only
(d) 1, 2, 3 and 4

36. Consider the following statements with reference to the Tsunamis:

1. It can be caused by submarine landslides due to movement of sediments along the floor of the sea.

2. The speed of the tsunami decreases as the tsunami moves from deep waters to the shallow waters.
3. The attraction of the moon plays an important role in the formation of Tsunamis.

Which of the above given statements is/are correct?

(a) 3 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

37. Consider the following statements with reference to the earthquakes:

1. Mercalli scale describes the earthquake's magnitude by measuring the seismic waves.
2. Richter scale describes the intensity of an earthquake based on its observed effects.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

38. Which among the following can be considered the best description for the Elastic Rebound Theory of Earthquakes?

This theory states that-

(a) emergence of the molten lava from inside the crust causes earthquakes.
(b) earthquakes are caused by the elasticity of the inner core of the earth.
(c) crust of the earth gradually stores stress that is released suddenly causing earthquakes.
(d) earthquakes are ruptures of the surface as the result of strong ground shaking.

39. Consider the following statements regarding the earthquakes:

Statement-I: The shadow zone of S-waves is larger than the shadow zone of P-waves.

Statement-II: The S-waves can travel only through solid and liquid materials.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect, but Statement-II is correct.

40. Consider the following pairs:

Volcano	Country
1. Mount Etna	Philippines
2. Mount Kilimanjaro	Indonesia
3. Mount Cotopaxi	United States of America (USA)

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

41. Consider the following pairs:

Terminologies related to an earthquake	Related information
1. Epicenter	The point within the earth from where energy is released during an earthquake.
2. Hypocenter	The first point on the surface of earth that experiences the earthquake shocks.
3. Fault Plane	The surface within the earth where two rocks slip past each other, leading to sudden release of energy.

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

42. In the context of the propagation of earthquake waves within the surface, consider the following statements regarding the 'Primary waves' (P-waves) and the 'Secondary waves' (S-waves):

Statement-I: The P-waves lead to stretching and squeezing of materials, whereas S-waves create troughs and crests in the materials.

Statement-II: The P-waves vibrate perpendicular to the direction of waves, whereas the S-waves vibrate parallel to the direction of waves.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

43. With reference to Richter scale, consider the following statements:

1. It measures the energy released during earthquakes.
2. Each one-point increase on the scale represents a 10-fold increase in the magnitude of the quake.
3. It considers the visible damage caused by the earthquake.

Which of the above given statements is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

44. With reference to the effects of Volcanic eruptions, consider the following statements:

1. It can increase the chances of occurrence of Tsunamis.
2. Volcanic eruptions elevate temperatures in atmosphere due to the release of significant quantities of sulphur and ash particles.
3. Volcanic aerosols from the volcanic eruptions can cause potential damage to earth's ozone layer.

Which of the above given statements is/are correct?

(a) 1 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

45. Consider the following statements regarding the distribution of volcanoes on the Earth:

Statement-I: The Circum-Pacific Belt accounts for more than 2/3rd of the world's volcanoes.

Statement-II: The subduction zone in the Circum-Pacific Belt results from the Pacific Oceanic plate converging with the surrounding Continental plates.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

46. Consider the following lakes:

1. Lake Toba, Indonesia
2. Lonar Lake, India
3. Lake Nyos, Cameroon
4. Lake Beaver, USA

How many of the above lakes are examples of Caldera/Crater lakes of volcanic origin?

(a) Only one
(b) Only two
(c) Only three
(d) All four

47. Consider the following statements:

Statement - I: Acidic lava is more viscous than basic lava.

Statement - II: Acidic lava has higher silica content than basic lava.

Statement - III: Acidic lava typically has a lower melting point compared to basic lava.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-II and Statement-III are correct and both of them explain Statement-I
(b) Both Statement-II and Statement-III are correct but only one of them explains Statement-I
(c) Only one of the Statement-II and Statement-III is correct and that explains Statement-I
(d) Neither Statement-II nor Statement-III is correct

48. Which of the following gases are released during volcanic eruptions?

1. Chlorine
2. Carbon monoxide
3. Hydrogen fluoride
4. Argon

Select the correct answer using the code given below:

(a) 2, 3 and 4 only
(b) 2 and 3 only
(c) 1 and 4 only
(d) 1, 2, 3 and 4

49. Consider the following statements with reference to 'Dykes':

1. Dykes are vertical geological structures formed when magma intrudes into cracks in the Earth's crust and solidifies into a wall-like feature.
2. Dykes in Maharashtra served as feeders for the volcanic eruptions that led to the formation of the Deccan Traps.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

50. Consider the following pairs:

Type of Volcano	Feature	Example
1. Shield volcano	Steep volcanoes with absence of cinder cones.	Mount Fuji
2. Caldera	Highly explosive volcanoes that collapse on themselves.	Crater lake
3. Composite volcano	Low viscosity lava that is made of basalt.	Hawaiian volcanoes

In how many of the rows given above the information is correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

51. In seismic studies, which one of the following is the correct description of the "Hypocentre"?

(a) It is the point where energy is released during an earthquake, causing seismic waves to travel in all directions.
(b) It is the point where seismic centres are located to monitor earthquake activity.
(c) It is the point on the surface of the earth directly above where the earthquake starts.
(d) It is the point where body waves interact with the surface rocks to generate surface waves.

52. With reference to earthquakes, consider the following statements:

1. All natural earthquakes take place in the lithosphere.
2. The energy released during an earthquake is measured using the Richter scale.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

53. With reference to Volcanic Rocks, consider the following statements:

1. They are formed at the depth in the Earth's crust.
2. They solidify faster than plutonic rocks.
3. Basalt is an example of a volcanic rock.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

54. With reference to seismic waves generated during earthquakes, consider the following statements about L-Waves and R- Waves:

1. L waves travel exhibiting vertical motion whereas R waves move horizontally from side to side along the ground surface.
2. L waves travel faster than R waves.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

55. With reference to the seismic waves, consider the following statements:

1. P waves are the first waves to be recorded on a seismograph during an earthquake.
2. S-waves are more destructive than P-waves because of their larger amplitudes.
3. Rayleigh waves cause only horizontal shearing of the ground.
4. Love waves usually travel slightly slower than Rayleigh waves.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 4 only
(d) 3 and 4 only

2.3. Minerals and Rock Systems

56. 'These types of rocks are formed by the cooling and solidification of molten rock (magma) from beneath the earth's crust. They are normally crystalline in structure and do not occur in strata (layers).'

Which one of the following rocks is described in the above paragraph.

(a) Sedimentary Rocks
(b) Metamorphic Rocks
(c) Igneous Rocks
(d) Calcareous Rocks

57. Consider the following statements with reference to different types of rocks:

1. Sedimentary rocks are stratified and non-crystalline.
2. Igneous rocks contain a large quantity of fossils.
3. Limestone is a type of metamorphic rock.

Which of the statements given above is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 only
(d) 1,2 and 3

58. Consider the following statements about the metamorphism and metamorphic rocks.

1. In metamorphism, recrystallisation and reorganisation of minerals occurs within rocks.
2. In metamorphic rocks, minerals get arranged in layers or lines by the process known as foliation.
3. Slate, gneiss and schist are some of the examples of metamorphic rocks.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 1, 2 and 3
(c) 1 only
(d) 2 and 3 only

59. Consider the followings statements:

1. Rocks in cold and dry climates always experience faster rates of chemical weathering than rocks in hot and wet climates.
2. The rate of biological weathering is most rapid in the desert ecosystem under windy conditions.
3. Calcite rocks are characterised by quick weathering due to richness in calcium.

Which of the statements given above is/are correct?

(a) 1 and 3 only
(b) 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

60. Which of the following are primarily the examples of Sedimentary Rocks?

1. Conglomerate
2. Coquina
3. Andesite
4. Dolomite
5. Gabbro

Select the correct answer using the code given below.

(a) 1, 2 and 4 only
(b) 1, 2, 4 and 5 only
(c) 2, 4 and 5 only
(d) 1, 2, 3, 4, and 5

61. With reference to igneous rocks, consider the following statements:

1. Igneous rocks generally occur as stratified rocks.
2. Igneous rocks are considered as good source of coal and petroleum.
3. Gabbro is an example of igneous rocks.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

62. Consider the following statements regarding the Porosity and Permeability in the rocks:

1. Permeability is the ease of flow of a fluid through a porous solid.
2. The surface water percolates well when the rocks are permeable.
3. Extremely porous rock will necessarily have good permeability.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

63. With respect to the Igneous rocks, consider the following statements:
1. Denudation of igneous rocks leads to the formation of plutonic rocks.
2. Granite and basalt are examples of igneous rocks.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

64. Consider the following statements about metamorphism and metamorphic rocks:
1. In metamorphism, recrystallisation and reorganisation of minerals occurs within rocks.
2. In some metamorphic rocks, minerals get arranged in layers or lines by the process known as foliation.
3. Orogenic movement is one of the factors responsible for formation of metamorphic rocks.
4. Limestone is an example of metamorphic rock.

Which of the statements given above are correct?
(a) 2, 3 and 4 only
(b) 1 and 3 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

65. With respect to Sedimentary rocks, consider the following statements:
1. They are formed through the process of lithification.
2. Fossils are most likely to be discovered in sedimentary rock deposits.
3. Schist and marble are common examples of Sedimentary rocks.

Which of the statements given above are correct?
(a) 2 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1 only

66. Coal, a major source of energy, is a-
(a) Mechanically formed sedimentary rock
(b) Chemically formed igneous rock
(c) Organically formed sedimentary rock
(d) Ancient metamorphic rock

67. It is a type of intrusive igneous landform characterized by its concave, saucer-shaped structure. It is formed beneath the Earth's surface, when molten magma pushes up between layers of other rock, creating this distinctive bowl-like shape. It is typically found in layered mafic igneous complexes, such as Bushveld complex in South Africa.

The Intrusive igneous landform described above is?
(a) Laccolith
(b) Lopolith
(c) Phacolith
(d) Batholith

68. Consider the following statements:

Statement I: Plutonic rocks have a larger grain size than Volcanic rocks.

Statement II: The rate of cooling of Plutonic rocks is faster than Volcanic rocks.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

69. In the context of Physical geography, what are Lapili, scoria and pumice?
(a) Sedimentary rocks formed by the compression of organic matter over millions of years.
(b) Minor landforms found in desert areas.
(c) Rocks formed due to glacial erosion
(d) Small rocks and materials that are products of volcanic eruption.

70. Consider the following rocks:

1. Quartzite
2. Marble
3. Schist
4. Sandstone
5. Slate

How many of the above are examples of metamorphic rocks?

(a) Only two
(b) Only three
(c) Only four
(d) All five

71. Cement is primarily a mixture of:

(a) Metallic minerals
(b) Ferrous minerals
(c) Non-metallic minerals
(d) Both metallic and non-metallic minerals

72. Consider the following:

1. Coal
2. Sandstone
3. Limestone
4. Chalk
5. Slate

How many of the above are examples of sedimentary rocks?

(a) Only two
(b) Only three
(c) Only four
(d) All five

73. In the context of Physical Geography, which of the following statements best describes the term "Lacoliths/Laccoliths"?

(a) It is a large dome-shaped intrusive body with a level base and connected by a pipe like conduit from beneath.
(b) It is an igneous intrusion with saucer shape, concave to the sky body.
(c) It is a lens-shaped mass of igneous rock occupying the crest of anticline.
(d) It is a large body of magmatic material that cools in the deeper depth of crusts.

74. With reference to the geological structure of the earth, consider the following statements about igneous rocks:

1. They are characterised by the lineated structure of minerals.
2. They are unfossiliferous in nature.
3. They are rich in aluminum and silica.
4. Granite and Basalt are types of igneous rocks.

Which of the statements given above are correct?

(a) 1, 2 and 3 only
(b) 2 and 4 only
(c) 2,3 and 4 only
(d) 1 and 3 only

2.4. CDT, SFS & Plate Tectonic Theory

75. Which of the following statements about the 'Continental Drift' Theory is correct?

(a) Pangaea first broke into two large continental masses as Laurasia and Panthalassa.
(b) The movement responsible for the drifting of the continents was caused by tectonic forces.
(c) The theory provided direct evidence and a mechanism to prove movement of continents.
(d) The presence of rocks of the same age across the oceans are due to the drift of the continents.

76. With reference to the Continental Drift Theory, consider the following statements:

1. Continental Drift refers to the horizontal movements of continents relative to one another over a long period of geologic time.
2. The matching of the shorelines of Africa and South America is one of the evidences proposed in support of the theory.
3. The Gravity, the Convection currents and the Primordial Heat are the main forces causing the Continental drift.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) 1 and 2 only
(d) 2 and 3 only

77. Which of the following is the correct description of continental margin?

(a) It refers to the region that starts at the bottom of continental shelf and then abruptly descends into a slope.
(b) It refers to the shallowest part of the ocean having an average gradient of 10 or even less.
(c) A transition zone that lies between continental shores and deep-sea basins.
(d) Gently sloping areas of ocean basin having smoothest and flattest regions of the world.

78. With reference to plate boundaries, consider the following statements:

1. Island arcs are the feature observed at the convergent plate boundary.
2. Volcanic eruptions at the diverging plate boundaries are more violent than those observed at the converging plate boundaries.
3. Rift valley is seen at the divergent plate boundary.
4. Earthquake's are absent at the transform plate boundary.

Which of the statements given above is/are correct?

(a) 1,2 and 3 only
(b) 1 and 3 only
(c) 2,3 and 4 only
(d) 1, 2,3 and 4

79. Consider the following:

1. The rocks on either side of the mid-oceanic ridges show similarities in terms of magnetic properties.
2. The continental rocks are much younger than the oceanic crust rocks.
3. The temperature near the mid-oceanic ridge is warmer as compared to the surfaces away from the ridge.

How many of the above can be considered as evidence of sea floor spreading?

(a) Only one
(b) Only two
(c) All three
(d) None

80. Consider the following pairs:

Minor Plate	Location
1. Nazca Plate	Between Central America and Pacific plate
2. Cocos Plate	Between South America and Pacific plate
3. Caroline Plate	Between the Philippine and the Indian plate (North of New Guinea)

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

81. In the context of plate tectonics, consider the following statements regarding the transform boundaries:

Statement-I: Earthquakes do not occur at the transform plate boundaries.

Statement-II: Transform plate boundaries lead neither to the creation nor the destruction of earth's lithosphere.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

82. Recently seen in the news, which of the following best describes the Clarion-Clipperton Zone (CCZ)?

(a) A deep-sea region in the Pacific Ocean rich in polymetallic nodules.
(b) A tectonic plate boundary in the Atlantic Ocean known for frequent earthquakes.
(c) A major upwelling zone in the Pacific Ocean responsible for high marine productivity.
(d) A coral reef ecosystem located between Australia and Southeast Asia.

83. In context of plate tectonics, consider the following geological formations:

1. Volcanoes
2. Rift Valley
3. Mid-oceanic Ridges
4. Ocean Trenches

How many of the above are formed at the divergent plate boundaries?

(a) Only one
(b) Only two
(c) Only three
(d) All four

84. Consider the following statement:

Statement I: Fold mountains are often associated with volcanic activity.

Statement II: Fold mountains are formed as a result of the collision of tectonic plates.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I
(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I
(c) Statement-I is correct, but Statement-II is incorrect
(d) Statement-I is incorrect, but Statement-II is correct

85. What is common among the Great African Rift Valley, Hunsruck, and Vosges Mountains?
(a) They were all formed due to the collision of two continental plates.
(b) They are all examples of erosion-formed landscapes.
(c) They all contain similar fossils, supporting the continental drift theory.
(d) They were all formed due to large-scale faulting in the Earth's crust.

86. Consider the following forces:
1. Attraction force between moon and the Earth
2. Convection currents in the Earth's mantle
3. Force generated due to rotation of earth
4. Tensional forces at plate boundaries

According to the Continental Drift Theory of Alfred Wegener, how many of the forces given above are responsible for drifting of continents?
(a) Only one
(b) Only two
(c) All three
(d) All four

87. With reference to geomorphology, consider the following statements about Convectional current theory:
1. Arthur Holmes, in the 1930s, proposed convection currents in the mantle as the force behind continental drift.
2. The theory proposes that radioactive elements generate thermal differences within the Earth's interior, causing the convection currents.

Which one of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

88. With reference to Alfred Wegener's Continental Drift Theory, which of the evidence given below supports the Continental Drift Theory?
1. The east coast of South America and the west coast of Africa seem to fit together.
2. Earthquakes and volcanic eruptions mostly occur along the margins of the Continents.
3. Discovery of sedimentary glacial deposits from different continents across the Oceans.
4. Earth's magnetic field has reversed after every few hundred thousand years.
5. Presence of mid-oceanic ridges on the seafloor.

Select the correct answer using the code given below:
(a) 1 and 3 only
(b) 2, 4 and 5 only
(c) 1, 3, 4 and 5
(d) 1, 2 and 3

89. Which of the following is/are the consequences of the northward movement of the Indian plate?
1. It is causing rise in the height of the Himalayas.
2. Frequent minor and major earthquakes are observed in the region.
3. It has led to the formation of Deccan traps.

Select the correct answer using the code given below:
(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

90. Which of the following pairs is/are correctly matched?

Theory/Law	Associated Scientist
1. Continental Drift	Edwin Hubble
2. Expansion of Universe	Alfred Wegener
3. Photoelectric Effect	Albert Einstein

Select the correct answer using the code given below:
(a) 2 and 3 only
(b) 3 only
(c) 2 only
(d) 1 only

91. What will happen when the Earth's Plate Tectonics movement stops?

1. The height of Mt Everest will get reduced gradually.
2. The Formation of the new continental and oceanic crust will be stopped.

Select the correct answer using the code given below:

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 Nor 2

2.5. Geomorphic Processes and Landforms

92. The depth of the weathering mantle, which varies with climatic conditions, is typically greatest in which of the following biomes?

(a) Tundra
(b) Desert
(c) Tropical forests
(d) Taiga

93. Which of the following are erosional desert landforms?

1. Barchans
2. Loess
3. Hoodoos
4. Mesas
5. Inselbergs

Select the correct answer from the code given below:

(a) 2, 3 and 4 only
(b) 3, 4 and 5 only
(c) 1, 3, 4, and 5 only
(d) 1, 2, 3, 4, and 5

94. The Kentucky region of the United States, the Yucatan peninsula of Mexico and the Cockpit country of Jamaica are well known for which of the following topographic features?

(a) Karst landforms
(b) Loess formations
(c) Mesas and buttes topography
(d) Ox bow lake formations

95. This is an important landform of river which provides valuable flood control and erosion protection services. It also helps to direct the flow of the river. It is formed parallel to a river channel due to repeated flooding events. It is composed of coarser material such as gravel and sand.

Which of the following landforms has been described in the passage above?

(a) Monadnocks
(b) Peneplain
(c) Natural levees
(d) Rapids

96. Which of the following landforms can be considered as depositional landforms formed by glaciers?

1. Esker
2. Drumlin
3. Aretes
4. Cirque

Select the correct answer using the codes below:

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 4 only

97. Consider the following statements regarding the Moraines:

1. It is formed by the deposition of unsorted glacial debris including gravel, sand and clay.
2. Moraines can be used to reconstruct the history of a glacier including its shape and size.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

98. Consider the following statements regarding the Alluvial Fans:

1. Alluvial fans are erosional landforms that are generally formed at the peak of the Mountains.
2. Alluvial fans cannot be formed underwater.
3. Fans formed due to mass wasting, without the aid of water, are called Colluvial Fans.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 3 only
(c) 2 and 3 only
(d) 1 and 3 only

99. Consider the following statements regarding the Meanders:

1. They are only formed at the upper course of the river mainly because of vertical erosion by the rivers.
2. Slip-off slope and River cliff are the landforms associated with the Meanders.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

100. Consider the following statements regarding the Caverns:

1. It is an underground cave formed by the action of water in a limestone area.
2. Borra caves in Andhra Pradesh is a well-known site of caverns in India.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

101. What is common among *Ria coasts, Dalmitian coast and Fiord coast?*

(a) They all have Submergent coastline.
(b) They all have Emergent coastline.
(c) They all have Concordant coastline.
(d) They all have Discordant coastline.

102. With reference to the terms related to the processes of erosion and weathering, consider the following pairs:

Term	Definition
1. Corrasion	It is the mechanical grinding of the river's traction load against banks and bed of the river
2. Corrosion	It is the gradual destruction or alteration of a material by chemical reaction.
3. Attrition	The process by which transported materials undergo wear and tear when they collide and roll into each other.

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

103. Which among the following conditions can be considered as favorable for the formation of Karst Topography?

The Presence of-

1. dense limestone near the surface.
2. moderate to heavy rainfall.
3. good groundwater circulation.

Select the correct answer using the codes given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

104. Rivers go through three main stages - the youthful or upper course, the mature or middle course, and the old or lower course. In this context, which of the following landforms are predominantly formed by the river in its upper course or youthful stage?

1. Interlocking spurs
2. Oxbow lakes
3. V-shaped valleys
4. Rapids
5. Plunge pools

Select the correct answer from the code given below:

(a) 1, 2 and 3 Only
(b) 1, 3 and 5 Only
(c) 3, 4 and 5 Only
(d) 1, 3, 4 and 5 only

105. Which of the following water bodies in India are examples of Ox-Bow lakes?

1. Chilika Lake
2. Pulicat Lake
3. Kanwar Lake
4. Deepor Beel

Select the correct answer using the codes given below:

(a) 1 and 2 Only
(b) 2 and 3 Only
(c) 3 and 4 Only
(d) 1 and 4 Only

106. Which of the following conditions are favourable for the formation of deltas?

1. Active lateral and vertical erosion at the upper course of the river.
2. Absence of heavy tides on coasts.

3. Presence of shallow sea adjoining the delta.
4. Presence of large lakes in the middle course of river.
5. Absence of strong currents running at right angles to the river mouth.

Select the correct answer from the codes given below.
(a) 1, 2 and 3 only
(b) 3, 4 and 5 only
(c) 1, 2, 3 and 5 only
(d) 1, 2, 3, 4 and 5

107. "It is a type of glacial erosional landform. It is a horseshoe shaped, deep, long and wide trough or basin with very steep to vertically dropping high walls at its head. It is a depression in which the firn or neve accumulates."

Which of the following landforms is described in the above passage?
(a) Hanging valley
(b) Aretes
(c) Cirque
(d) Bergschrund

108. Consider the following statements about the "Intermontane plateaus":

1. These are generally formed because of the continual denudation by agents like water streams and glaciers.
2. These are some of the highest and the most extensive plateaus in the world.
3. The Deccan plateau is an example of intermont plateau.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

109. Consider the following statements regarding the Eperiogenic movement of Earth:

1. These movements acts only horizontally along the surface of the earth.
2. These movements are responsible for the formation of continents.

Which of the statements given above is/are correct?
(a) 1 Only
(b) 2 Only
(c) Both 1 & 2
(d) Neither 1 nor 2

110. Consider the following statements regarding the processes of Weathering and Erosion:

1. Weathering cannot occur if there is no erosion of the rocks.
2. Unlike Weathering, Erosion does not involve any movement of fragments of rock.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

111. Consider the following pair:

Types of Mass Movements	Characteristic /causes
1. Solifluction	Slow downslope flowing fine grained rock debris saturated or lubricated with water
2. Debris flow	Heavy rains causing saturation of the soil and regolith with water.
3. Debris avalanches	high velocity flows of large volume of rocks that result from collapse of a mountainous slope.

Which of the pairs given above is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 3 only
(d) 1, 2 and 3

112. Which one of the following is the most appropriate reason for the occurrence of the phenomenon of land subsidence?
(a) The movement of a mass of rock, debris, or earth down a slope resulting into heavy pressure on the land.
(b) Heavy rainfall resulting from thunderstorms or cloud burst leading to flooding of the land.
(c) The large amounts of groundwater have been withdrawn from the aquifers below the ground.
(d) Collapse of the vent or the conduit of volcano during explosive blast of the thin and fluid lava.

113. Which of the following statements best describes 'Outwash Plain'?
(a) These are plains mainly formed by the upliftment of a part of the seafloor or continental shelf.

(b) These are plains formed by deposition of sediments by glacial meltwater at the terminus of a glacier.
(c) These are plains formed in desert regions at the foot of a mountain or hill.
(d) These are plains formed by deposition at the bed of the river or lake.

114. Consider the following statements regarding a geomorphological landform called Mesas:

1. It is a plateau with a flat top and steep sides.
2. It is usually formed in arid regions.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

115. With reference to 'Playas', consider the following statements:

1. They are flat-bottom depressions found in the interior of desert basins.
2. They may serve as sources of mineral deposits and salts.
3. These are depositional landforms formed by the sudden rains in the deserts.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

116. How are the Gorges different/similar from/ to the Canyons?

1. Both Gorges and Canyons can be formed by erosional activities of streams or rivers.
2. Gorges and Canyons are both deep, but Canyons are generally wider than Gorges.
3. Unlike Gorges, Canyons are never found in arid regions.

Select the correct answer using the code given below:

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

117. Which of the following erosional landforms are developed by running water?

1. Plunge Pools
2. Alluvial fans
3. River Terraces
4. Incised Meanders
5. Natural Levees

Select the correct answer using the codes given below:

(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 2, 3, 4 and 5 only
(d) 1, 2, 3, 4 and 5

118. Consider the following pairs:

Depositional Landforms made by Rivers	Features
1. Point Bars	Loop-like channel patterns developed over the flood and delta plains
2. Braided Channels	Network of river channels separated by small islands
3. Oxbow lakes	Separate body of water formed by cutting-off from a meander

Which of the pairs given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 3 only

119. With reference to 'Delta Formation', consider the following statements:

1. Deltas are wetlands formed at the mouth of the river in its senile stage.
2. The high velocity of the river along with finer sedimentary load are the essential condition for delta formation.
3. The delta of river Ganga is shaped by the rise and fall of tides in the Bay of Bengal.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

120. With reference to 'Stalactite and Stalagmite', consider the following statements:

1. The elongated structure of minerals hanging from the ceilings of caves is known as stalagmite.
2. The formation of the stalactite is directly dependent on the source of the rock above a cave.

3. These cave features are not found in Indian subcontinent.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 3 only

121. With reference to 'Landforms formed by Groundwater', consider the following statements:
1. Sinkhole is an opening which is circular at the top and funnel-shaped towards the bottom.
2. Lapies are the spherical mounds formed through deposition of limestone by groundwater.
3. Uvala is a compound sinkhole formed by the collection of multiple smaller individual sinkholes.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

122. Which of the following pairs are correctly matched?

List I	List II
1. Ventifacts	These are pebbles faceted by sand-blasting and thoroughly polished by wind abrasion.
2. Yardangs	These are steep-sided ridges of rocks separated from one another by long grooves.
3. Peneplain	It is the landform produced by fluvial erosion

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 3 only
(c) 1 only
(d) 1, 2 and 3

123. Which of the following situations would most likely result in the formation of a 'Lagoon'?
(a) Sedimentary beds of rivers/streams become gentler due to continued erosion.
(b) A River shifts laterally making a series of natural levees.
(c) Barrier bars and spits are formed at the mouth of a bay and they block it.
(d) Waters spill over the banks during flooding above the river bed.

124. What is the difference between an Alluvial plain and an Outwash Plain?
1. Outwash plains are located on the floor of the ocean, whereas Alluvial plains are glacial sediments deposited on land surface.
2. Unlike Outwash plains, Alluvial plains are usually fertile due to its loamy texture.

Select the correct answer using the codes given below:
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

125. With reference to 'Karst Topography', consider the following statements:
1. It is formed from the erosional effects of underground water on soluble limestones.
2. In Karst region, there is a general absence of surface drainage as most of the surface water goes underground.
3. The region provides raw material used in the manufacturing of cement.

Which of the statements given above is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

126. Consider the following pairs:

Types of Sand Dunes	Features
1. Barchans	Crescent-shaped with a steep slip face
2. Linear dunes	Pointed ridges and slip faces on at least three sides.
3. Dome dunes	Circular in shape and do not have a slip face
4. Parabolic dunes	U-shaped with vegetation-anchored tips

Which of the pairs given above are correctly matched?

(a) 1 and 2 only
(b) 2 and 4 only
(c) 1, 3 and 4 only
(d) 3 and 4 only

127. With reference to 'Meanders', consider the following statements:

1. They are landforms associated with only flat-bottomed glacial valleys.
2. They are the result of both erosional and depositional processes.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

128. With reference to 'Stream Erosion', consider the following statements:

1. Hydraulic action is the mechanical loosening and removal of the material from the rocks due to pressure exerted by the running water.
2. Abrasion involves wear and tear of the load sediments through the process of mutual impacts and collisions.
3. Corrosion implies slow but steady chemical action of the flowing stream water on the rocks.
4. Attrition is the process by which irregular bed of the stream is smoothed by the constant friction.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 4 only
(c) 1 and 3 only
(d) 2, 3 and 4 only

129. Which of the following are the correct statements regarding the significance of presence of bars, barriers and beaches?

1. Off-shore bars provide defense against storm and tsunami by absorbing most of their destructive force.
2. Barrier islands offer an important habitat for a wide variety of fish, shellfish, sea bird and sea turtle species.
3. Beaches help to protect the coastal structures by creating enough space for the ocean current energy to dissipate.

Select the correct answer using the codes given below:

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

130. Which one of the following statements correctly explains the landform of 'Bajada'?

(a) It is a large sheet of ice that reshapes the landscape around them as they move.
(b) It is a broad slope of debris spread along the lower slopes of mountains by descending streams.
(c) It is a narrow and shallow channel cut into soil by the erosive action of flowing water.
(d) It is a naturally occurring desert rock whose shape resembles a mushroom.

131. Consider the following statements regarding the different types of Wells:

1. In Artesian wells, the water is trapped between layers of impermeable rock.
2. Dug wells are shallow and are subject to contamination from nearby surface sources.
3. As the pressure inside the Artesian wells is low, pumps are required to extract it.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

132. With reference to the chemical weathering phenomena, consider the following statements:

1. The carbonation process speeds up with a decrease in temperature.
2. In oxidation, rocks containing iron turn to rust.
3. Chemical hydrolysis process results in decrease of the volume of rock.
4. Under the soil cover, chemical weathering of rock becomes extremely slow.

Which of the statements given above are correct?

(a) 1, 2 and 3 only
(b) 1 and 2 only
(c) 1, 3 and 4 only
(d) 2, 3 and 4 only

133. It is a collection of broken rock fragments at the base of a cliff or other steep rocky mass that has accumulated through periodic rock falls. It is the result of physical and chemical weathering acting on a rock face.

Which among the following explains the above description correctly?
(a) Pyroclast
(b) Colluvium
(c) Screes
(d) Sand dunes

134. With reference to the significance of weathering, consider the following statements:
1. Weathering tends to help in soil enrichment.
2. Weathering helps in the mining and quarrying of the rocks.
3. It also helps in the augmentation and concentrations of minerals.

Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

135. Consider the following statements regarding the terms related with Groundwater:
1. Vadose zone is an unsaturated zone of soil where water is totally absent.
2. Phreatic zone is the zone where the crustal pores and fractures are saturated with water.
3. The Groundwater table marks the upper limit of the zone of saturation.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

136. Consider the following statements with reference to the process of Exfoliation:
1. It can occur due to expansion and contraction induced by temperature changes.
2. It is the combined effect of biological and chemical weathering.
3. Exfoliation due to pressure release is also known as sheeting.

Which of the above given statements is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

137. Which among the following can be considered as the reasons to activate mass movements?
1. Undercutting of steep slopes
2. The removal of vegetation
3. Heavy rainfall
4. Animal movement

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 1 and 4 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

138. Which among the following can be considered as a reason for frequent occurrence of landslides in Himalayas?
1. Relatively younger mountains
2. High range of diurnal temperature change
3. Composed of igneous rock
4. Lack of isostatic equilibrium

Select the correct answer using the code given below:
(a) 2, and 3 only
(b) 1, 2 and 4 only
(c) 1, 3 and 4 only
(d) 1 and 4 only

139. With reference to the difference between Canyons and Gorges, consider the following statements:

Statement-I: A gorge is almost equal in width at its top as well as its bottom, whereas a canyon is wider at its top compared to its bottom.

Statement-II: Gorges usually form in hard rocks, whereas canyons commonly form in horizontal bedded sedimentary rocks.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect Statement-II is correct.

140. "As the ice mass moves downhill, it plucks and abrades the bedrock, gradually carving out a bowl-shaped depression at the head of a valley. This bowl-shaped depression is known as:

(a) Cirque
(b) Hanging Valley
(c) Arete
(d) Roche moutonnée

141. Consider the following landforms:

1. Barchans dunes
2. Mushroom rocks
3. Pedi Plains
4. Inselberg

How many of the above given landforms are depositional landforms found in the desert regions?

(a) Only one
(b) Only two
(c) Only three
(d) All four

142. consider the following factors:

1. Scarce rainfall.
2. Lesser vegetation cover.
3. Presence of Soluble rocks.

How many of the above factors promote the formation of Karst Topography in a geographical region?

(a) Only one
(b) Only two
(c) All three
(d) None

143. Consider the following statements regarding a 'glacial valley' and a 'river valley':

1. While glacial valleys generally have a V-shaped profile, river valleys have a U-shaped profile.
2. While hanging valleys are a prominent feature observed in glacial valleys, meanders are commonly found in river valleys.

Which of the statements given above is/ are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

144. Which of the following best explains the picturesque landforms, known as 'Fjords (fiords)'?

These are the:

(a) plateau regions characterized by deep valleys and meandering rivers.
(b) arid landscapes featuring sand dunes and sparse vegetation.
(c) elevated terrains with flat expanses encircled by mountain ranges.
(d) steep valleys carved by glaciers and subsequently filled with seawater.

145. With reference to soil science, which of the following is the least likely cause of the formation of 'Hardpans'?

(a) Natural compaction of soil over time
(b) Human activities such as driving heavy machinery over the soil or tilling the soil too deeply
(c) Chemical reactions that cause soil particles to bind together
(d) Excessive watering of the soil

146. With respect to geomorphic processes, consider the following events/processes:

1. Mountain building processes
2. Earthquakes involving local relatively minor movements
3. Upliftment of Plateaus
4. Mass wasting movements

How many of the events/processes given above involve the process of Diastrophism?

(a) Only two
(b) Only three
(c) All four
(d) None

147. With respect to phenomena of Weathering, consider the following statements:

1. Weathering is considered an in-situ process as it involves minimal to no movement of materials.
2. Compared to dry climates, the weathering process is faster in humid climates.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

148. Geomorphic processes are the natural forces and actions that contribute to the formation, development, and alteration of the Earth's landforms, in this regard consider the following statements:

1. Phenomenon of weathering and erosion is a prerequisite for the process of Mass Movement.
2. Gravity alone can facilitate the process of Mass movement in absence of other geomorphic agents like wind or running water.

3. Solifluction is a type of mass movement which involves the gradual downslope movement of water-saturated rock debris.

Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

149. With reference to various geomorphic processes on earth, which of the following statements best describes 'slump', a type of Landslide?
(a) Swift rolling or gliding of earth debris without backward rotation.
(b) Virtually unrestricted descent of earth debris from a vertical or overhanging face.
(c) Glide of individual rock masses along bedding, joint, or fault surfaces.
(d) Slip of one or multiple rock debris units with a reverse rotation.

150. Consider the following forms of weathering:
1. Burrowing by organisms
2. Acids produced by algae
3. Cryofracturing
4. Exfoliation

How many of the above options are the forms of biological weathering?
(a) Only one
(b) Only two
(c) Only three
(d) All four

151. In the context of intrusive volcanic landforms, which of the following statements best describes the term "dykes"?
(a) These are horizontal structures formed by lava cooling on the ground surface.
(b) These are vertical wall-like intrusive structures formed when lava solidifies perpendicular to the ground through cracks and fissures.
(c) These are large dome-shaped intrusive landforms developed beneath the Earth's surface.
(d) These are structures formed by lava cooling in synclines and anti-clines under the Earth's surface.

152. "Calcium sulphate takes in water and turns to gypsum, which is more unstable than calcium sulphate. Continued repetition of this long process causes fatigue in the rocks and leads to their disintegration".

Which one of the following processes of weathering is correctly described in the above paragraph?
(a) Unloading and expansion
(b) Mechanical Weathering
(c) Weathering by Hydration
(d) Frost weathering

153. Consider the following statements:

Statement I: Shiva lingam at Amarnath in India is a form of natural Stalagmite.

Statement II: Stalagmites are generally formed of calcium carbonate or other mineral deposits that precipitate out from mineralized water flowing in the cave environment.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

154. With reference to Coastal landforms, the Ria coast, Dalmatian coast and Estuarine coast are the classic examples of:
(a) Submergent Coasts.
(b) Emergent Coasts.
(c) Fault Coasts.
(d) Compound Coasts.

155. Consider the following statements in respect of ox-bow lakes:
1. Ox-bow lakes are predominantly formed during the young stage of a river.
2. They are formed through both erosional as well as depositional activities of the river.
3. Kanwar lake in Bihar is Asia's largest ox-bow lake.

Which of the above given statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 2 only
(d) None of the above

156. Consider the following conditions:
1. Active vertical and lateral erosion in the upper course of the river.
2. Shallow depth of the Sea adjoining the delta.

3. Absence of large lakes in the course of the rivers.
4. Presence of strong Ocean current alongside the Coast.

How many of the above conditions are favourable for the formation of river deltas?

(a) Only one
(b) Only two
(c) Only three
(d) All four

157. With respect to glacial landforms, consider the following:

1. Outwash plain
2. Moraines
3. Kame
4. Arete
5. Hanging valleys

How many of the above are depositional glacial landforms?

(a) Only two
(b) Only three
(c) Only four
(d) All five

158. Consider the following economic activity:

1. Mining activities of metals like lead.
2. Geothermal energy generation.
3. Availability of raw materials for cement industry.

How many of the above economic activities can be performed in Karst Topography?

(a) Only one
(b) Only two
(c) All three
(d) None

159. Consider the following lakes:

1. Wular lake
2. Titicaca lake
3. Caspian Sea
4. Kodaikanal lake

How many of the above given lakes have been formed due to the tectonic activities?

(a) Only one
(b) Only two
(c) Only three
(d) All four

160. With reference to Coastal landforms, which of the following correctly describes the meaning of the term 'Tombolo'?

(a) A steep rock face formed as a result of wave action in the Coastal areas.
(b) An island separated from the mainland by a narrow strip of land.
(c) An elongated body of water separated from a larger body of water by a shallow coral reef.
(d) A narrow sandbar linking an island to the mainland or another island.

161. With reference to Geological formation, consider the following statement regarding 'Festoons':

Statement I: Festoons are a chain of volcanic islands that emerge above sea level, marking the continuation of the mainland.

Statement II: Festoons originate generally at Convergent plate boundaries between two Oceanic plates with different densities.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

162. With reference to the Glacial movement, consider the following statements:

Statement-I: When a row of wooden poles is positioned horizontally in a straight line on the surface of a glacier, the glacier's movement causes them to align in a curved shape.

Statement-II: The sides of glaciers move slower compared to the centre as friction force is greater at the sides.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

163. Which of the following statements best explains the phenomenon of 'River Capture'?

(a) The formation of river deltas through sediment deposition at the river mouths.
(b) The redirection of a river's flow due to changes in sediment deposition along its course.
(c) The process where the flow of one river is diverted to another river or drainage system.
(d) The erosion of riverbanks leading to the widening of the river's channel.

164. It is a geological feature typically found along the banks of rivers, especially those with swiftly flowing water. It is characterized by a steep, often vertical bank formed by erosion caused by the river's current.

Which one of the following features of river geology is described in the above paragraph?
(a) River Delta
(b) Meander
(c) Floodplains
(d) River cliff

165. Which one of the following processes primarily contributes to the formation of Ribbon lakes in glaciated regions?
(a) Melting of remnant glacial ice trapped in rock depressions.
(b) Deposition of glacial till along sides of a valley
(c) Deep glacier troughs filled with sea water.
(d) Erosion by glacial ice in valleys with varying rock hardness.

166. With reference to a type of chemical weathering process called 'Solution', consider the following statements:
1. It plays a significant role in the formation of karst topography.
2. It makes the sedimentary rocks containing limestone and dolomite more susceptible to weathering.
3. The occurrence of this process is enhanced by Warm and Wet climate.

Which of the statements given above are correct?
(a) 2 and 3 only
(b) 1 and 2 only
(c) 1, 2 and 3
(d) 1 and 3 only

167. Which of the following statements correctly describes the term "Solifluction"?
(a) The slow downslope movement of water saturated soil and rock fragments.
(b) The breaking down of organic matter in soil into minerals.
(c) Upward movement of soil or rock caused by the expansion of water as it freezes in the underlying soil.
(d) The accumulation and melting of snow in mountain areas, leading to the formation of hollows and various landforms.

168. Consider the following with respect to a geographical landform:

It is typically located in regions with limited vegetation, making it prone to significant erosion by both rivers and wind. At the same time, this geological formation is composed of sedimentary rock layers topped by a harder, erosion-resistant rock layer. This combination leads to the formation of land features characterized by steep slopes and broad, flat summits.

Which of the following landforms is described in the above passage?
(a) Mesas
(b) Inselberg
(c) Fjords
(d) Eskers

169. Consider the following statements:
1. The height of Mont Blanc, the highest mountain in Western Europe, has been shrinking over the past two years.
2. Reduced summer precipitation in recent years could be the reason behind this shrinkage.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

170. With reference to the Fold mountains, consider the following statements:
1. They are typically associated with high volcanic activity.
2. They are often rich in mineral deposits such as tin and copper.
3. Alps & Andes mountains are examples of fold mountains.

Which of the statements given above are correct?
(a) 2 and 3 only
(b) 1 and 2 only
(c) 1, 2 and 3
(d) 1 and 3 only

171. With reference to landforms formed by river actions, consider the following statements about Ox-bow lakes:

1. They are primarily formed during the mature stage of a river.
2. Kanwar Lake is the largest freshwater ox-bow lake in India.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

172. Consider the following Landform:

'It is an isolated heap of free sand. It has the outline of a crescent, and the points of the crescent are directed downwind.'

Which among the following is described in the above statement?

(a) Loess
(b) Seif Dunes
(c) Barchans
(d) Yardangs

173. Which one of the following is not related to wind erosion/abrasion?

(a) Wind gap
(b) Zeugen
(c) Ventifacts
(d) Inselberg

174. Consider the following description:

1. It is a longitudinal coast where mountain ranges run parallel to the coastline.
2. It has deep, sheltered harbours but generally lacks distinguished ports.
3. It is named after a region along the Adriatic Sea.

Which one of the following coasts is best described above?

(a) Ria coast
(b) Fiord coast
(c) Estuarine coast
(d) Dalmatian coast

175. It is a type of drainage pattern where the primary tributaries of rivers flow parallel to each other and the secondary tributaries join them at a right angle.

Which of the following drainage patterns is best described in the above statement?

(a) Dendritic
(b) Trellis
(c) Radial
(d) Centripetal

176. Consider the following landforms:

1. Cirque
2. Horns
3. Glacial Troughs
4. Outwash Plains
5. Drumlins

How many of the landforms listed above are primarily formed through glacial erosion?

(a) Only two
(b) Only three
(c) Only four
(d) All five

177. In the context of Continental shelves, consider the following statements:

Statement-I: They are narrow or almost absent along the coasts of Chile.

Statement-II: They are generally absent in regions where the coasts are extremely mountainous.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct, and Statement-II explains Statement-I
(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I
(c) Statement-I is correct, but Statement-II is incorrect
(d) Statement-I is incorrect, but Statement-II is correct

178. With reference to landforms, 'Hamada', 'Erg' and 'Reg' are features of-

(a) Glacial landforms
(b) Karst landforms
(c) Desert landforms
(d) Fluvial landforms

179. Consider the following statements regarding stalagmites and stalactites:

1. Both stalagmites and stalactites are depositional landforms.
2. Stalagmites develop from the ceiling of a cave, whereas stalactites rise from the floor of the cave.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

180. In the context of geomorphology, the term 'Festoon' refers to:

(a) A loop-shaped chain of islands formed at the convergence of tectonic plates.
(b) A steep-sided canyon formed by river erosion.
(c) A ring-shaped coral reef island enclosing a shallow lagoon
(d) A crescent-shaped sand dune formed by unidirectional wind in arid regions.

181. Geos and Gloups are formed due to the action of:

(a) groundwater
(b) coastal waves
(c) glaciers
(d) wind

182. In the context of desert or arid regions, Wadis refers to:

(a) permanent rivers found in desert regions.
(b) large sand dunes found in desert areas.
(c) fertile oases formed by underground water sources in deserts.
(d) dry riverbeds that carry water only during rainy seasons.

183. In the context of geomorphology, what does the term "Bog Burst" refer to?

(a) A flood caused by sudden release of water from a glacial lake.
(b) A rapid flow of volcanic debris and mud during an eruption.
(c) A sudden collapse of an underground limestone cavern.
(d) A rapid downslope movement of saturated peaty soil.

184. Consider the following statements:

Statement-I: Mechanical weathering is prominent in deserts.

Statement-II: Deserts experience a high diurnal temperature range.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II does not explain Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

185. Which one of the following statements best describes the concept of an 'artesian well'?

(a) A water reservoir from which groundwater flows out automatically under its own pressure.
(b) A water reservoir created by deposition of water in depressions left behind by glaciers.
(c) A water reservoir in which water is collected by making a stone wall across a small river.
(d) A water reservoir from which water is taken out using bamboo pipes.

186. Consider the following statements about Canyons:

1. They are characterized by steep step-like slopes and are wider at the top than at the bottom.
2. They commonly form in horizontal bedded sedimentary rocks.
3. Gandikota Canyon of South India, often referred to as the Grand Canyon of India, is formed by the Sharavati River.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

187. With reference to Landforms formed by running water, Consider the following pairs:

Landforms	Description
1. Monadnocks	These are the erosional landforms of running water which are resistant remnants of a hill of bedrock standing above the surrounding area.
2. Peneplains	Flat plain like lowlands formed by reduction of highlands through erosion by running water.
3. Point bars	They are sediments deposited in a linear fashion by flowing waters along the river bank and are found on the concave side of meanders of large rivers.

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

188. Consider the following statements about meanders:

1. The direction of curvature of the meander is influenced by the Coriolis force.
2. Meander formation is not dependent on deposition or erosion of river sediments.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

189. Consider the following statements with reference to cirques:

1. They are pointed peaks bounded on at least three sides by glaciers.
2. The formation of tarn lakes is associated with cirques.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

190. With reference to moraines, consider the following statement:

1. They are depositional landforms formed by the deposits of glacial till.
2. It can only be found in areas where glaciers are currently present.
3. Glacial Lake Outburst Floods (GLOFs) can be caused due to the failure of moraine dams.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 3 only
(d) 1, 2 and 3

191. These geomorphic features are often formed by glaciers carving out deep U-shaped valleys. They are long, narrow and deep inlets of sea water that reach far inland. Coral reefs and skerries are some of its main features. They are found mainly in Norway, Chile, Greenland and Alaska.

The above paragraph best describes which one of the following landforms?

(a) Outwash plains
(b) Drumlins
(c) Fjords
(d) Eskers

192. With reference to desert landforms, consider the following information:

Types of Landforms	Nature of formation	Characteristics
1. Barchans	Depositional	Crescent-shaped topography
2. Sief	Erosional	Long, narrow chain of dunes.
3. Inselberg	Erosional	Small and isolated mountains.

In how many of the above given rows, information is correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

193. Arrange the following in descending order in the context of the proportion of freshwater they hold out of total fresh water available on planet Earth:

1. Glacier and Ice caps
2. Groundwater
3. Streams and rivers
4. Lakes

Select the correct answer using the codes given below:

(a) 1-2-3-4
(b) 2-1-3-4
(c) 1-2-4-3
(d) 2-3-1-4

194. Consider the following description:

It is a flat-topped seamount that shows evidence of gradual subsidence through various stages, eventually becoming a flat-topped submerged mountain. These features are most commonly found in the Pacific Ocean.

Which of the following terms best fits the above description?

(a) Atoll
(b) Submarine Canyons
(c) Abyssal plain
(d) Guyot

195. Which of the following statements are correct regarding the phenomena of 'River Rejuvenation'?

1. Rainfall is a mandatory prerequisite for the occurrence of River Rejuvenation.
2. It may result in the formation of waterfalls, rapids and incised meanders.

Select the correct answer using the code given below:

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

196. Kettle Lakes are the landforms associated with the action of which of the following?

(a) Wind
(b) Glaciers
(c) Running Water
(d) Ground Water

197. With reference to Coastal landforms in India, consider the following statements:

Statement I: Erosional activity dominates on the western coast of India, whereas depositional activity dominates on the eastern coast.

Statement II: The western coast of India is a low-lying sedimentary coast.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation for Statement I
(b) Both Statement I and Statement II are correct but Statement II is not the correct explanation for Statement I
(c) Statement I is correct, but Statement II is incorrect
(d) Statement I is incorrect, but Statement II is correct

198. With reference to the Continental shelf, consider the following statements:

1. The continental shelf is one of the main sources of the world's petroleum and natural gas.
2. The continental shelf is narrower where the fold mountains run parallel or close to the coast.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

199. Arrange the following landforms of Karst topography in increasing order as per their size:

1. Swallows or Swallow holes
2. Uvalas
3. Sink holes

Select the correct answer using the codes given below:

(a) 1-2-3
(b) 1-3-2
(c) 2-1-3
(d) 2-3-1

200. Consider the following lakes:

1. Vembanad lake
2. Chilka lake
3. Pulicat lake
4. Periyar lake

How many of the above given lakes are classified as lagoons?

(a) Only one
(b) Only two
(c) Only three
(d) All four

201. Consider the following statements regarding 'natural levees':

1. These landforms are predominantly found in desert landscapes.
2. These are considered as depositional landforms.

Which of the statements given above is/ are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

202. Consider the following statements:

1. A region with many deep gullies or ravines is called a badland topography.
2. Badland Topography is formed by the erosional activity of wind and water on soft sedimentary rocks.
3. Chambal basin is an example of badland topography.
4. Mushroom Rocks are a typical feature of badland topography.

How many of the statements given above are correct about Badland Topography?

(a) Only one
(b) Only two
(c) Only three
(d) All four

203. With reference to the depositional landforms created by the glaciers, consider the following pair:

Landforms	Description
1. Moraines	Deep, narrow coastal valleys formed by glacial erosion.
2. Eskers	Deposits of layered sand and gravel resulting from the inland streams in the glaciers.
3. Erratics	Boulders transported by glaciers and deposited in locations far from their origin

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

204. The Western Ghats of India is a tectonically stable region. In spite of this, why do landslides occur in Western Ghats?
1. Western Ghats are mostly made up of sedimentary rocks and unconsolidated deposits.
2. The slopes of the Western Ghats are very steep.
3. The mechanical weathering of rocks is predominant in western Ghats due to frequent temperature changes.
4. Prolonged periods of dry weather conditions lead to soil degradation in the western ghats region.

Select the correct answer using the code given below:
(a) 1, 2 and 3
(b) 1, 3 and 4
(c) 2 and 3 only
(d) 2, 3 and 4

205. Consider the following statements :
1. The humus content in the soil is higher in the tropical areas in comparison to the tundra soils.
2. Chemical weathering is higher in tropical regions compared to the tundra regions.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

206. Which one of the following chemical weathering processes is primarily responsible for the formation of Karst topography?
(a) Hydration
(b) Carbonation
(c) Oxidation
(d) Reduction

207. In the landform development process which of the following statements best describes the term "Saltation"?
(a) It is a one type of wind erosional process.
(b) It is the process in which salt accumulates in the top horizon of the soil.
(c) It is a one type of glacial depositional process.
(d) It is the process which results in leaching salts from the top layer of the soil.

208. In the context of various landforms, which one of the following statements most correctly describes the term 'Lapies'?
(a) A banded calcareous deposit in limestone caves.
(b) A large depression formed when a number of swallow holes coalesce.
(c) A depositional landform formed due to dripping of water from the cave surface.
(d) The highly corrugated and rough surface of limestone characterized by low ridges and pinnacles.

209. "This Canyon lies in the south-western portion of the Colorado Plateau of United States of America. It is a steep-sided canyon carved by the Colorado River. It is the largest canyon in the United States. Native peoples have inhabited the canyon area for thousands of years, and the Pueblo people consider the area to be a holy pilgrimage site."

The above passage describes which of the following geographical locations?
(a) Royal Gorge Canyon, Colorado
(b) The Grand Canyon, Arizona
(c) Antelope Canyon, Arizona
(d) King Canyon, California

210. In context to 'Geomorphology', which of the following are not an erosional landform?
(a) Capes and Bays
(b) Stack and Stumps
(c) Gloup and Geos
(d) Spits and Bars

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211. With reference to the fluvial erosion consider the following statements:

1. Channel developed by Gully erosion is deeper than channel developed by Rill erosion.
2. Rill and Gully erosion results in the formation of badland topography.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 and 2

212. Which among the following statements is *incorrect* with reference to with Levees?

(a) Levees becomes oxbow lake along the side of the river over time.
(b) Levees can protect against floods.
(c) Levees are produced naturally by sedimentation.
(d) Levees direct the flow of the river.

213. Match List 1 and List II and select the correct answer using the code given below:

List I (Geographic feature)	List II (Country)
1. Great Victoria Desert	Australia
2. Grand Canyon	Canada
3. Lake Winnipeg.	New Zealand
4. Southern Alps.	USA

	A	B	C	D
(a)	1	2	4	3
(b)	1	4	2	3
(c)	3	2	4	1
(d)	3	4	2	1

214. Which of the following is/are the geologic features that can be seen off a Rocky Coast?

1. Wave-cut terrace
2. Sea Arches and Stacks
3. Barrier Bars
4. Lagoons

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 3 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

215. Consider the following statements:

1. Cirque lakes or tarns are formed by the volcanic activity.
2. Lakes formed by landslides are short lived.
3. Lakes are temporary features of the earth crust.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All of the Above

216. Consider the following statements regarding weathering processes:

1. In oxidation, rocks containing iron turns to rust.
2. In hydration, a new solution is formed as chemicals in rock interact with water.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

217. Consider the following pairs of types of soil erosion and their primary causes:

Erosion	Primary Cause
1. Splash erosion	Canal Irrigation
2. Sheet erosion	Heavy rainfall
3. Rill erosion	Concentration of surface water in depressions

Which of the pairs given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 3 only
(d) 1 and 2 only

218. An aquifer is defined as a formation of sizeable mass of sufficiently saturated permeable material that can yield water to wells and springs. In this context, which of the following options are correct about Aquifer?

1. Unconsolidated sand and gravel deposits form the best aquifers.
2. Sedimentary materials constitutes the largest percentage of earth's aquifers.
3. Clays which constitute a large proportion of pores, are good aquifers.

Select the correct answer using the code given below:

(a) 1 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

SOLUTIONS

2.1. Earth's Interior and Structure

1. Solution: (d)

Exp) Option d is the correct answer.

The earth is made up of several concentric layers like crust, mantle, outer core and inner core. Mechanically, it can be divided as lithosphere, asthenosphere, mesosphere, and barysphere.

Statement 1 is incorrect: The interior layer of the Earth is known as the Core or barysphere. It is further divided as inner core and outer core. It is primarily composed of Iron and nickel (nife). Olivine is a major constituent of the mantle/mesosphere.

Statement 2 is incorrect: The temperature in the barysphere is estimated to be as high as 3,500°F, and is also subjected to extremely high pressure. In this, though the composition of both the inner and outer core is same, but due to difference in the amount of pressure, **the outer core is in liquid state while the inner core is in solid state. Hence, the whole of barysphere is not in a liquid state, rather only the outer core is in the liquid state.**

2. Solution: (a)

Exp) Option a is the correct answer.

Geysers are **springs of hot water and steam** that may spout up to a height of 150 feet from the earth beneath. **The jet of water is usually emitted with an explosion and is often triggered off by gases seeping out of the heated rocks. Old Faithful** is the world's best-known geyser. It is located in **Yellowstone National Park (USA).**

Statement 1 is correct: A geyser is a vent in Earth's surface that periodically ejects a column of hot water and steam. Natural geysers are formations that absorb heat from the earth. Hot water is sprouted from its reservoir with a massive amount of force and is accompanied by a huge amount of steam. **This process generates an intensive amount of heat.** The water and steam sprouted from the geysers are **owed to the pipe channels known as conduits** found below the surface of the geysers.

Statement 2 is incorrect: Geysers are rare formations and are **largely distributed across five countries on the earth's surface, i.e. US, Russia, Chile, New Zealand and Iceland.** Most of the world's geysers are mainly confined to **three major areas – Iceland, the Rotorua district of North Island, New Zealand and Yellowstone Park in the USA.** So, statement 2 is incorrect.

3. Solution: (c)

Exp) Option c is the correct answer.

The Longitudinal motion of P waves can pass through solids, liquids, and gases, while liquids and gases prevent the shearing motion of S waves.

Statement 1 is correct: Both S and P waves travel faster through more dense material. **Since density generally increases with depth, waves speed up as they move deeper into the Earth.** The change in density also causes the waves to follow curved paths as they move through the Earth.

Statement 2 is incorrect: At **core-mantle boundary boundary**, the sheer **S waves disappear** completely. **P waves refract significantly** at the core-mantle boundary providing more information about the changes in composition here. It is the disappearance of S waves in this region that shows that the **outer core is liquid.**

Statement 3 is incorrect: Hotter areas cause waves to travel more slowly, revealing the presence of hot spots. Molten regions cause P waves to slow down and completely stop S waves. Since **asthenosphere** is a **partially molten area**, the S waves don't completely disappear but only slows down. This shows up as another change in velocity and a **weakening of S waves.**

Statement 4 is correct: Sudden jumps in seismic velocities across a boundary are known as seismic discontinuities. It denotes the presence of discontinuity in earth's interior.

Important Tips

The curving of seismic waves is similar to the refraction that occurs when a light ray passes through an interface between two media (like air to glass), but rather than an abrupt change in direction the waves undergo a gradual change in direction as the density changes gradually with depth. They undergo gradual refraction that can eventually reach a critical angle, resulting in them turning back towards the surface.

The disappearance of the S waves and the refraction of the P waves create shadow zones where no waves are detected. Consistent with the liquid outer core preventing the propagation of shear waves, no S waves are detected past 103 degrees from the origin of the waves. P waves make shadow zone between 103 and 143 degrees. This is due to the refraction patterns of P wave that creates a gap in P wave detection.

The S waves completely disappear while passing through the Gutenberg discontinuity.

The **Gutenberg discontinuity** is the transition zone between the mantle and core located at the depth of 2900 km beneath the earth surface. In this zone the velocity of seismic waves changes suddenly. The **velocity of P wave decreases and S wave completely disappear at this depth in this zone.** The mantle core boundary does not remain constant. As the heat of the earth's interior constantly but slowly dissipated, the molten core within earth solidifies and shrinks, causing the core mantle boundary to slowly move deeper and deeper within the earth's core.

4. Solution: (b)

Exp) Option b is the correct answer.

The discontinuity is a zone within the earth where a sudden change in physical properties, such as the velocity of earthquake waves, occurs. Such a zone marks the boundary between the different layers of the earth such as between the core and mantle.

Option a is correct: The **Conrad discontinuity** was named after the seismologist Victor Conrad). It is a transition zone between upper and lower Crust. This boundary is observed in various continental regions at a depth of 15 to 20 km; however, it is **not found in oceanic regions**. In passing through the Conrad discontinuity the velocity of longitudinal seismic waves increases abruptly from approximately 6 to 6.5km/sec.

Option b is incorrect: The mohorovicic discontinuity is the transition zone between the crust and mantle. It was discovered by Andrija Mohorovicic in the year of 1909. It lies at the depth of 35km beneath the continents and 8 km beneath the oceanic crust. It lies almost entirely within the lithosphere except beneath the Mid Oceanic Ridge where it is defined as the lithosphere and asthenosphere boundary. There is a **change in the velocity of the P wave from 8 km/sec below the Moho to 6km/sec** above the Moho discontinuity.

Option c is correct: Lehmann Discontinuity is the transition zone between outer and inner core. It is an abrupt increase of P-wave and S-wave velocities at the depth of 220 km. It appears beneath continents, but not usually beneath oceans.

Option d is correct: Repetti discontinuity is the transition zone between **outer mantle** and **inner mantle**. It is located approximately between 660 and 700 km deep. Passing through this discontinuity, seismic waves increase its speed.

5. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Different types of rocks distinguish lithospheric crust and mantle. **Lithospheric crust is characterized by gneiss (continental crust) and gabbro (oceanic crust).** Below the Moho, the mantle is characterized by peridotite, a rock mostly made up of the mineral's olivine and pyroxene.

Statement 2 is incorrect: The asthenosphere is the denser, weaker layer beneath the lithospheric mantle. The temperature and pressure of the asthenosphere are so high that rocks soften and partly melt, becoming semi-molten. **The asthenosphere is much more ductile than either the lithosphere or lower mantle.** The asthenosphere is generally more viscous than the lithosphere. The very slow motion of lithospheric plates "floating" on the asthenosphere is the cause of plate tectonics.

Statement 3 is correct: The **outer core** is 2300 km thick that extends to a radius of ~3,400 km. In this region, the density is estimated to be much higher than the mantle or crust, ranging between 9,900 and 12,200 kg/m3. The outer core is believed to be composed of 80% iron, along with nickel and some other lighter elements. Because of its high temperature, the outer core exists in a **low viscosity fluid-state that undergoes turbulent convection and rotates faster than the rest of the planet.** This causes **eddy currents to form in the fluid core**, which in turn creates a dynamo effect that is believed to cause the Earth's magnetic field.

Statement 4 is correct: The **inner core is composed primarily of iron and nickel** and has a radius of ~1,220 km.

The temperature of the inner core is estimated to be about ~5,400 °C. The only reason why iron and other heavy metals can be solid at such high temperatures is because their melting temperatures dramatically increase at the pressures present there.

6. Solution: (a)

Exp) Option a is the correct answer.

Earth's interior is made of different kinds of materials. Each of those materials are different from each other by their physical and chemical properties, such as temperature, density etc. Unique layers are there according to their characteristics inside the earth. All those layers are separated from each other through a transition zone. These transition zones are called discontinuities.

Pairs 1 and 4 are *incorrect*ly matched: The Conrad discontinuity (named after the seismologist Victor Conrad) is considered to be the border between the **upper continental crust and the lower one. It is a transition zone between SIAL and SIMA.**

Mohorovicic discontinuity, also known as moho discontinuity is the boundary **between Earth's Crust and its Mantle**. The moho lies at the depth of 30-50 km below the continents and 5-10 km below the sea level in the ocean.

Pair 2 is correctly matched: The **Gutenberg discontinuity** occurs within Earth's interior at a depth of about 2,900 km below the surface, where there is an abrupt change in the seismic waves (generated by earthquakes or explosions) that travel through Earth. It marks the boundary between two sections of the earth's interior, known as the **lower mantle** (which is considered solid) and the underlying **outer core (believed to be molten).**

Pair 3 is *incorrect*ly matched: Lehman discontinuity is the transition zone between **outer and inner core**. The Lehmann discontinuity is an abrupt increase of P-wave and S-wave velocities at the depth of 220±30 km, discovered by seismologist Inge Lehmann. It appears beneath continents, but not usually beneath oceans, and does not readily appear in globally averaged studies.

Repetti discontinuity is the transition zone between Outer mantle and inner mantle.

7. Solution: (d)

Exp) Option d is the correct answer.

The Earth consists of diverse elements, with the **outer layer existing in solid form** and the **interior in a hot, molten state**. Approximately **98% of the Earth's crust** is made up of eight key elements: **oxygen, silicon, aluminium, iron, calcium, sodium, potassium, and magnesium**. The remaining composition includes elements such as **titanium,**

hydrogen, phosphorus, manganese, sulfur, carbon, nickel, and others.

The Major Elements of the Earth's Crust:

	Elements	(%) By weight
Option 2	Oxygen	46.60
Option 1	Silicon	27.72
Option 4	Aluminium	8.13
Option 6	Iron	5.00
Option 3	Calcium	3.63
Option 5	Sodium	2.83

8. Solution: (c)

Exp) Option c is the correct answer.

Direct sources involve obtaining materials or data directly from the Earth's interior, while **indirect sources involve inferring information about the Earth's interior by studying its effects on the surface, without directly studying materials beneath its surface.** Both types of sources are crucial for developing a comprehensive understanding of the Earth's internal structure and dynamics.

Option 1 is correct: The **gravitational force is an important 'indirect' source** of information about the interior of the Earth, because:

1) It is not the same at the different latitudes of the surface. It is greater at poles than equator. This **reveals that distance of the center of the Earth to the equator is greater than the distance of the centre from the poles.**
2) The gravity differs according to the mass of the material. **This reveals uneven distribution of materials (mass) within the earth.**

Option 2 is incorrect: Surface rocks provide a **direct source of information** about the Earth's interior by offering tangible geological samples from the outermost layer, the crust. Geologists analyze the mineral composition, structure, and fossils within surface rocks to unravel the Earth's history, understand tectonic processes, and infer conditions within the deeper layers. Also, **volcanic rocks erupted onto the surface offer direct insights** into the composition of the mantle.

Option 3 is correct: Meteors that reach the Earth are an important indirect source of information about the interiors of the Earth. **Meteors are developed out of materials same as, or similar to the Earth. So, they also provide insights into the interiors of the Earth.**

Option 4 is correct: Seismic activity serves as **an indirect source** of information about Earth's interior through the study of seismic waves generated by events like earthquakes. As these waves travel through the Earth, **their behavior, speed, and pathways provide crucial data for inferring the composition, density, and structure** of the planet's various layers. These help in determining the boundaries between the crust, mantle, and core.

Option 5 is correct: Magnetic fields are another indirect source of information about the Earth's interior. Magnetic field is influenced by the movement of molten iron and nickel in the outer core. **These variations in the magnetic field offer insights into the dynamics of the Earth's core, helping scientists understand phenomena like geomagnetic reversals.** By studying magnetic anomalies on the Earth's surface, researchers indirectly probe the behavior and composition of materials in the inaccessible depths of the Earth's interior.

9. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is incorrect: The crust is the Earth's outermost layer and is **less dense than both the mantle and the core. The average density of crust is 2.7 g/cm3.**

1) The density of the upper mantle varies between 2.9 g/cm3 and 3.3 g/cm3. The density of lower mantle ranges between 3.3 g/cm3 to 5.7 g/cm3
2) The density of the outer core ranges from 9.9 g/cm3 to 12. 2 g/cm3. The density of the inner core ranges from 12.6 g/cm3 to 13 g/cm3.

Hence, crust is the least dense layer of the earth.

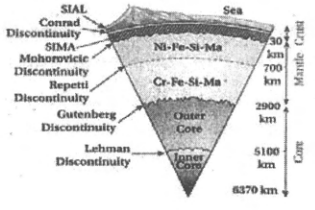
Statement 2 is correct: The mantle is the middle layer in the structure of the Earth. It is about 2900 kms thick and **comprises of around 84% of the Earth's overall volume.** The mantle **exhibits variable viscosity**, being predominantly solid rock yet less viscous at tectonic plate boundaries and mantle plumes. **The aesthenosphere**, which is in partially molten form, is also part of the mantle. The mantle activities contribute to phenomena like **volcanoes, seafloor spreading, earthquakes, and orogeny, shaping the planet's geological features.**

Statement 3 is incorrect: The outer core is in liquid state, whereas the inner core is in the solid state. The outer core is composed of iron and nickel in the molten state. The inner core is mainly composed of solid iron and nickel, therefore, also called the NiFe layer. **The core (inner core and the outer core) accounts for just about 16 per cent of the earth's volume but 33% of earth's mass.**

10. Solution: (a)

Exp) Option a is the correct answer.

The Earth's structure comprises four primary components: the crust, mantle, outer core, and inner core. Each layer possesses distinct chemical compositions and physical states, which can influence conditions on the planet's surface. These layers are demarcated by transition zones known as discontinuities.



The discontinuities as they occur from Crust to Core of Earth are as follows:

Option 2- Conrad Discontinuity: This discontinuity corresponds to the sub-horizontal boundary in the continental crust at which the seismic wave velocity increases in a discontinuous way. This boundary is observed in various continental regions at a **depth of 15 to 20 km**, but it is not found in oceanic regions. The Conrad discontinuity is considered the border between the upper continental and lower continental crusts.

Option 4- Mohorovicic Discontinuity (Moho): The Moho is the boundary between the crust and the mantle of Earth. The Moho **is 5 to 10 kilometers below the ocean floor**, and 20 to 90 kilometers beneath typical continental crusts, with an average of 35 kilometers (22 mi).

Option 3- Repetti Discontinuity: The Repetti Discontinuity is the area where the **outer mantle changes into the inner mantle**. It is the transition zone between the outer mantle and the inner mantle.

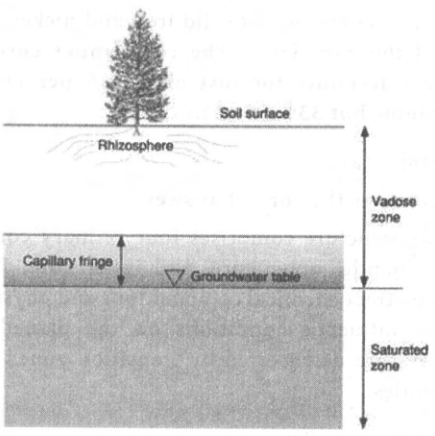
Option 1- Lehman Discontinuity: Lehman Discontinuity is the boundary between the outer core and the inner core. The Lehmann discontinuity is an abrupt increase of P-wave and S-wave velocities at the depth of 220 km (140 mi). Its thickness is 220 km.

Important Tips

1) The **Gutenberg discontinuity** is the transition zone between the Earth's mantle and core. It occurs at a depth of about 2,900 kilometers below the surface.
2) The Gutenberg discontinuity is where there is a sudden change in the seismic waves that travel through the Earth. At this depth, primary seismic waves slow down, and secondary seismic waves disappear completely.

11. Solution: (c)

Exp) Option c is the correct answer.



The Vadose Zone refers to the Earth's terrestrial subsurface extending from surface to the groundwater table.

It acts as the Earth's Critical Zone that **facilitates transport, storage, and transfer of water to groundwater reservoirs**. Within this zone, **water content and solute concentrations undergo continual changes** due to various processes including infiltration, leakage, evaporation, root water uptake, and water redistribution, **influenced by both natural and human-induced factors**. The **soil is the uppermost layer** of the vadose zone. This zone may extend much deeper than the surficial soil layer and **includes unsaturated rock formations** and alluvial materials to depths of 100 m or more. Hence, option c is the correct answer.

12. Solution: (a)

Exp) Option a is the correct answer.

The **inner core** is the **Earth's innermost layer**, located at the very center of the planet. It begins at approximately **5,150 km** below the Earth's surface and extends to the center at **6,378 km**. The inner core plays a crucial role in generating Earth's magnetic field, as its interactions with the outer core drive the geodynamo process.

Statement 1 is correct: The **Earth's inner core** is **primarily made up of iron (Fe) and nickel (Ni),** along with small amounts of lighter elements like oxygen, sulphur, and silicon. Due to immense pressure, it remains in a solid state despite the extremely high temperatures, which exceed 5,000°C.

Statement 2 is incorrect: The **inner core does not constitute 50% of Earth's total mass.**

1. In reality, the **entire core** (both inner and outer) **accounts for about 32% of Earth's mass**, while the inner core itself makes up only a small portion of this.

2. The Earth's mass is largely distributed in the **mantle**, which constitutes around **67%** of Earth's total mass, while the **crust** contributes approximately **1%.**

13. Solution: (b)

Exp) Option b is the correct answer.

The configuration of the surface of the Earth is largely a product of the processes operating in the interior of the Earth. Thus, it is necessary that we know certain details of the interior of the Earth.

Our knowledge about the interior of the earth is based on some direct sources and analysis of some indirect materials/ sources.

Option 1 is correct. The most easily available direct source of information is surface rock or the **rocks we get from mining areas.** Deep earth mining and drilling reveal the nature of rocks deep down the surface.

Option 2 is incorrect. An indirect source of information are the meteors that at times reach the earth. The material and the structure observed in the meteors are similar to that of the earth. They are solid bodies developed out of materials same as, or similar to, our planet. Hence, this becomes yet another source of information about the interior of the earth.

Option 3 is incorrect. The gravitational force (g) is an indirect source of information about Earth's interior. The gravitational force is not the same at different latitudes on the surface. The gravity values differ according to the mass of material. The reading of the gravity at different places is also influenced by many other factors. These readings differ

from the expected values. Such a difference is called a gravity anomaly. Gravity anomalies give us information about the distribution of mass of the material in the crust of the earth. But that is an indirect source of information.

Option 4 is correct. Volcanic eruption forms a source of obtaining direct information about the interior of the Earth. The **molten material (magma) emerging through volcanoes** onto the surface of the earth, becomes available for laboratory analysis and gives information about Earth's interior materials.

Option 5 is incorrect. Seismic activity is also one of the most important indirect sources of information about the interior of the Earth. The study of seismic waves provides a complete picture of the layered interior.

Magnetic surveys also provide information about the distribution of magnetic materials in the crustal portion, and thus, provide information about the distribution of materials in Earth's interior.

14. Solution: (c)

Exp) Option c is the correct answer.

The Earth is composed of several concentric layers, one inside another. The outermost layer, called the crust, is the thinnest of all the layers. It is approximately 35 km thick beneath the continents and only about 5 km thick under the ocean floors. The crust is the Earth's outer solid layer and is brittle in nature. Its thickness varies between oceanic and continental regions.

Statement I is correct: The **density** of material in the **oceanic crust** is 3 g/cm3 whereas **continental crust** rocks have a **density** of 2.7 g/cm3

Statement II is incorrect: The oceanic crust primarily consists of **dense basalt rocks**, which are rich in silica, iron, and magnesium. In contrast, **the continental crust** is mainly composed of **granite**, a rock that contains higher levels of silica and alumina.

Hence option c is correct: Statement I is correct, but Statement II is incorrect.

15. Solution: (d)

Exp) Option d is the correct answer.

The Earth is divided into three different layers namely crust, mantle, and core. "Crust" is the outermost layer of our terrestrial planet. The middle layer is called the mantle. The core is the innermost layer of Earth.

Statement 1 is correct. The core is mostly composed of nickel and iron. It is sometimes referred to as the NiFe layer.

Statement 2 is correct. Earth's core is further divided into 'inner core' and 'outer core'. The outer core is in liquid state while the inner core is in solid state. **The outer core acts as a barrier between the inner core and the rest of the Earth.** This barrier allows Earth's inner core to spin independently and not necessarily align with the rest of the planet. **As a result, the inner core rotates a little differently than the rest of the planet.**

Statement 3 is incorrect. Mantle is the main source of magma that emerges onto Earth's surface during volcanic eruptions.

Statement 4 is correct. The Earth's magnetic field is generated in the fluid outer core by a self-exciting dynamo process. The liquid metal of the outer core has very low viscosity, meaning it is easily deformed and malleable. It is the site of violent convection. Here the convective energy from the slow-moving molten iron is converted to electrical and magnetic energy.

Important Tips

- Earth's core is the very hot, very dense center of our planet. The primary contributors to heat in the core are the decay of radioactive elements, leftover heat from planetary formation, and heat released as the liquid outer core solidifies near its boundary with the inner core.
- Another key element in Earth's core is sulfur—in fact 90 percent of the sulfur on Earth is found in the core.
- The core is made of two layers: the outer core, which borders the mantle, and the inner core. The boundary separating these regions is called the Bullen discontinuity or Lehmann discontinuity.
- As the entire Earth slowly cools, the inner core grows by about a millimeter every year. The inner core grows as bits of the liquid outer core solidify or crystallize. Another word for this is "freezing". The growth of the inner core is not uniform. It occurs in lumps and bunches, and is influenced by activity in the mantle.

16. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: The **Mohorovicic Discontinuity** or **Moho** is the **boundary** that **separates the Earth's crust from the mantle.** Specifically, it marks the boundary between the **lower crust and the upper mantle.** It is located at a depth of about **5 km** beneath the ocean floor and **30 km** beneath the continents.

Option b is incorrect: The **Repetti Discontinuity** marks the **boundary between the upper mantle and lower mantle.** It is found at depths of around 660 km.

Option c is incorrect: The **Gutenberg Discontinuity separates the mantle from the core.** Specifically, it marks the boundary between the **lower mantle and the outer core.** It is located at a depth of about **2,900 km.** This boundary is characterized by the transition from solid mantle rocks to the liquid outer core.

Option d is incorrect: The **Lehmann Discontinuity** lies between the **liquid outer core and the solid inner core,** occurring at a depth of about **5,100 km.**

17. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct. About 70% of the earth's crust is covered by oceans. **The oceanic crust originates from the Mid-oceanic Ridges and spreads towards the continents**

and then it goes down to magma again and it melts. This could be the reason that we always find the younger oceanic crust and it is not more than 200 million years old. All of the oceanic crusts are made up of basalt rock which is a volcanic rock. Some deposits of continental sediments near the continents and organic depositions in the deep-sea zone are also found there. Oceanic crusts are heavier and its density is 3.0 g/cm3. Primary wave (P) travels through this layer at a speed of 7 km/s. Mineral compositions of the rocks are mainly silica and magnesium. This layer is known as Sima.

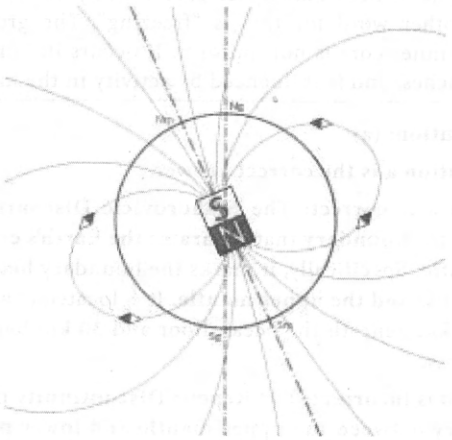
Statement 2 is correct. Outgassing is the release of gas, previously dissolved, trapped, frozen or absorbed in some material (e.g., rock). It occurs mainly **along mid-ocean ridges**, subduction zones and at magma hotspots. Pockets of carbon dioxide exist in the Earth's crust. Volcanic eruptions and earthquakes can release these gas pockets.

18. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. The axis of earth is **inclined to the plane of the ecliptic at an angle of 66 ½ degree**, giving rise to different seasons and varying lengths of day and night. Earth rotates on its own axis, tilted at an angle of 23.4 degrees every 23 hour 56 minutes giving rise to Day and Night.

The axis of the Earth's magnetic field is inclined at an **angle of about 15 degrees with the geographical axis.**



Statement 2 is correct. The North Magnetic Pole moves over time due to magnetic changes in Earth\'s core. In 2001, it was determined by the Geological Survey of Canada to lie west of **Ellesmere Island in northern Canada at 81.3°N 110.8°W.** It was situated at 83.1°N 117.8°W in 2005.

Statement 3 is correct. The **Thumba Equatorial Rocket Launching Station (TERLS)** is an Indian spaceport operated by the Indian Space Research Organisation. It is located in **Thumba, Thiruvananthapuram** which is near the southern tip of mainland India, very close to earth's magnetic equator.

19. Solution: (d)

Exp) Option d is the correct answer.

The location on which sinking of a tectonic plate occurs is called a ***subduction zone.*** There are three ways in which convergence can occur. These are:

1) between an oceanic and continental plate;
2) between two oceanic plates; and
3) between two continental plates.

Deep ocean trenches, Fold mountains with active volcanoes, island arcs, and seismic fault lines are examples of features that can form along converging plate tectonic boundaries. Other features include accretionary wedges, forearc basins, backarc basins and remnant arcs.

Statement 1 is correct. Oceanic trenches are formed at subduction zones. Oceanic plates meet continental plates in the water, so trenches are formed as the oceanic plate goes under the continental plate. These trenches can be very deep if the plate that is subducting (going down) is an older and colder plate. Younger oceanic plates are less dense and the angle will be shallower.

Statement 2 is correct. Forearc basins are between the island arc and the trench, whereas the backarc is behind the island arc. These basins catch sediment (dirt and small rocks that wash away in rain) runoff from the island arcs.

Statement 3 is correct. Volcanic arcs form parallel to subduction zones. As one plate descends under another plate, it heats up and becomes magma. The magma will rise through the crust until it reaches the surface. This magma creates a chain of volcanoes or a volcanic arc near the boundary of the top plate. There are two types of arcs: island arcs and continental arcs.

Statement 4 is correct. Accretionary wedges are pieces of the subducting plate that have broken off at the trench.

2.2. Volcanism and Earthquakes

20. Solution: (c)

Exp) Option c is the correct answer.

A volcano is an opening in the earth's crust through which gases, molten rocks materials (lava), ash, steam etc. are emitted outward in the course of an eruption.

Statement 1 is correct. In shield volcanoes, **very high fluid basaltic lava flows**. The lava spreads in a thin layer before cooling . These are the **largest of all volcanoes** of the world. A large, broad cone with sides sloping gently away from the centre are the features of these volcanoes. They become explosive if somehow water gets into the vent; otherwise, they are characterised by **low-explosivity.**

Statement 2 is correct. Composite volcanoes often result in explosive eruptions. Along with lava, large quantities of pyroclastic material and ashes find their way to the surface. This material accumulates in the vicinity of the vent openings leading to formation of layers, and this makes the mounts appear as composite volcanoes. Andesitic lava along with pyroclastic material accumulates in the vicinity of the vent openings leading to the formation of layers, and this makes the mounts appear as a composite volcano or a stratovolcano (divided into layers).

21. Solution: (d)

Exp) Option d is the correct answer.

Ring of Fire is a long horseshoe-shaped seismically active belt of earthquake epicentres, volcanoes, and tectonic plate boundaries that fringes the Pacific basin.

Seventy-five percent of Earth's volcanoes are located along the Ring of Fire. Ninety percent of Earth's earthquakes occur along its path, including the planet's most violent and dramatic seismic events. The abundance of volcanoes and earthquakes along the Ring of Fire is caused by the amount of movement of tectonic plates in the area.

Statements 1, 3 and 4 are correct. Bolivia, Chile, Ecuador, Peru, Costa Rica, Guatemala, Mexico, United States, Canada, Russia, Japan, Philippines, Australia, **Papua New Guinea, Indonesia**, New Zealand, and Antarctica are some of the **important places located in the ring of the fire.**

Statement 2 is correct. Mount Fuji, Japan's tallest and most famous mountain is an active volcano in the Ring of Fire. Mount Fuji sits at a **"triple junction"**, where three tectonic plates (the **Amur Plate, Okhotsk Plate,** and **Philippine Plate**) interact.

22. Solution: (d)

Exp) Option d is the correct answer.

An Earthquake is the shaking of the surface of the Earth resulting from a sudden release of energy in the Earth's Crust.

Statement a is correct. Earthquake magnitude is a measure of the "size," or amplitude, of the seismic waves generated by an earthquake source and recorded by seismographs. **Magnitude measures the energy released at the source of the earthquake.** Magnitude is determined from measurements on seismographs.

Statement b is correct. An earthquake has one magnitude unit. The magnitude does not depend on the location where measurement is made. Since 1970, the Moment Magnitude Scale has been used because it supports earthquake detection all over the Earth.

Statement c is correct. The Richter scale measures the magnitude of earthquakes, and the Mercalli scale measures their intensity. Richter scale use a formula based on the amplitude of the largest wave recorded on a specific type of seismometer and the distance between the earthquake and the seismometer.

Statement d is incorrect. Earthquake Intensity scales, (not the magnitude of earthquakes) are based on the observed effects of the shaking, such as the degree to which people or animals were alarmed, and the extent and severity of damage to different kinds of structures or natural features. Earthquake intensity measures how strongly the earthquake impacts a specific location. The maximal intensity observed, and the extent of the area where shaking was felt can be used to estimate the location and magnitude of the source earthquake; this is especially useful for historical earthquakes where there is no instrumental record.

23. Solution: (d)

Exp) Option d is the correct answer.

Mountains which are built up from material ejected from fissures in the earth's crust are commonly known as volcanic mountains.

Statement 1 is incorrect: Volcanic mountains are, in fact, volcanoes which are built up from material ejected from fissures in the earth's crust. **They are commonly found in the circum-Pacific belt; however, they can also be often found in places where tectonic plates diverge or converge. They can also be found in alpine-Indonesian mountain belt, East African-Arabian belt, Eurasia, and Atlantic's.**

Statement 2 is incorrect: Cinder cones are also known as pyroclastic cones are the smallest and simplest type of volcanic mountains. Whereas, composite mountains/ Composite cones are large volcanoes (many thousands of feet or meters tall) generally composed of lava flows, pyroclastic deposits, and mudflow (lahar) deposits, as well as lava domes.

Statement 3 is correct: Mt. Merapi is the most active volcano in Indonesia and has erupted regularly since 1548. It is one of the most active volcanos of Indonesia. It is located near the centre of the island of Java and Indonesia's cultural capital, Yogyakarta

24. Solution: (d)

Exp) Option d is the correct answer.

Seismicity may also occur away from tectonically stable regions. Such seismic activities, located within the plates away from the plate margins, are called **intraplate seismicity**. They are generally confined to the weaker zones of the earth's crust.

These weaker zones are represented by **faults or fractures** within the earth's crust and are generally **less intense** than the ones found near the **plate margins.**

Statement 1 is correct. One such zone of in-plate seismicity is the **Narmada-Son lineament**, cutting across the northern plane.

Activation of Narmada south fault caused the **devastating Jabalpur earthquake** (6.0 M) on May 22, 1997.

Statement 2 is correct. The earthquake of January 26, 2001 of **Gujarat** was also caused by the growing 'in-plate stress: whole **Kutch is a fault.** Bhuj, lies close to the Allah bund fault.

Hence, in-plate seismicity is due to the reactivation of concealed shields (stable parts of the Earth) and release of energy.

Statement 3 is correct. The intraplate seismicity caused the **Latur** earthquake of 30th September, 1993 in Peninsular India. It is characterised by a rather localised earthquake occurrence on the segmented fault lineaments. These fault zones are a zone of weakness which facilitates the faulting process.

Important Tips

Structurally, the Peninsular Plateau forms the **India shield**. A shield is, basically, a large tectonically stable area made up of crystalline igneous and metamorphic rocks of Precambrian age.

The east-west trending **Son-Narmada Tapti (SONATA) lineament** separates the Aravalli craton from the Bastar and Singhbhum cratons.

25. Solution: (b)

Exp) Option b is the correct answer.

Earthquake waves are basically of two types — body waves and surface waves. Body waves are generated due to the release of energy at the focus and move in all directions travelling through the body of the earth. There are two types of body waves. They are called P and S-waves. P-waves move faster and are the first to arrive at the surface. These are also called 'primary waves".

Statement 1 is *incorrect.*

P-waves vibrate parallel to the direction of the wave. This exerts pressure on the material in the direction of the propagation. As a result, it creates density differences in the material leading to stretching and squeezing of the material.

The direction of vibrations of **S-waves** is perpendicular to the wave direction in the vertical plane. Hence, they **create troughs and crests** in the material through which they pass. Surface waves are considered to be the most damaging waves.

Statement 2 is correct.

S-waves arrive at the surface with some time lag. These are called secondary waves. An **important fact about S-waves is that they can travel only through solid materials.** This characteristic of the S-waves is quite important. It has helped scientists to understand the structure of the interior of the earth.

Statement 3 is correct.

Earthquake waves get recorded in seismographs located at far off locations. However, there exist some specific areas where the waves are not reported. Such a zone is called the 'shadow zone'. The study of different events reveals that for each earthquake, there exists an altogether different shadow zone. It was observed that seismographs located at any distance within 105° from the epicentre, recorded the arrival of both P and S-waves. However, the seismographs located beyond 145° from epicentre, record the arrival of P-waves, but not that of S-waves.

Thus, a zone between 105° and 145° from epicentre was identified as the shadow zone for both the types of waves. The **entire zone beyond 105° does not receive S-waves**. The **shadow zone of S-wave is much larger than that of the P-waves**. The shadow zone of P-waves appears as a band around the earth between 105° and 145° away from the epicentre. The shadow zone of S-waves is not only larger in extent but it is also a little over 40 per cent of the earth surface.

26. Solution: (c)

Exp) Option c is the correct answer.

Mantle plume is an **upwelling of abnormally hot rock** within the earth's mantle which carries **heat upward** in narrow, rising columns, **driven by heat exchange** across the core-mantle boundary. Eventually, the rising column of hot rock reaches the base of the lithosphere, where it spreads out, forming a mushroom-shaped cap to the plume. Heat transferred from the plume raises the temperature in the lower lithosphere to above melting point, and forms magma chambers that feed volcanoes at the surface. It is a **secondary way** through which earth loses heat.

Option 1 is correct. Mantle plumes are also thought to be the **cause of volcanic centres** known as **hotspots** and probably have also caused **flood basalts**. When a plume head encounters the base of the lithosphere, it is expected to flatten out against this barrier and to undergo widespread decompression melting to form large volumes of basalt magma. It may then erupt onto the surface.

Option 2 is correct. Plumes are a **secondary way** that Earth loses heat, much less important in this regard than is **heat loss at plate margins**. Some scientists think that plate tectonics cools the mantle, and **mantle plumes cool the core.** Two of the most well-known locations that fit the mantle plume theory are Hawaii and Iceland as both have volcanic activity.

27. Solution: (d)

Exp) Option d is the correct answer.

There are two categories of seismic waves known as body and surface waves. Body waves move along the internal division of the Earth and further divided into two sub-types. These are primary and secondary waves designated by the P and S. Surface waves as the name itself indicates moves at the external division of the Earth's surface with two subtypes namely Rayleigh and Love waves.

Statement 1 is correct: Body waves are generated due to the release of energy at the focus and move in all directions travelling through the body of the earth. Hence, the name body waves. The body waves interact with the surface rocks and generate a new set of waves called surface waves. These waves move along the surface.

Statement 2 is correct: Surface waves arrive at the surface after the Body waves as their speed is slower than Body waves. In the Body waves, Primary or P waves are the first to arrive and then secondary or s waves. The surface waves are the last to report on seismograph as they are the slowest.

Statement 3 is correct: Surface waves are more destructive. They cause displacement of rocks, and hence, the collapse of structures occurs. It makes everything upon the surface to be in motion including buildings, bridges, transmission lines and numerous man-made objects. These waves generally affect only the surface of the earth and die out at smaller depth. These waves cover the longest distances of all the seismic waves. Though their speed is slower than P and S waves, but these are most violent and destructive

Statement 4 is correct: Shallow earthquakes produce stronger surface waves; the strength of the surface waves is reduced in deeper earthquakes.

28. Solution: (d)

Exp) Option d is the correct answer.

A crater is a landform consisting of a hole or depression on a surface. It is usually caused either by an object hitting the surface, or by geological activity like volcanic explosion.

Statement 1 is correct: Craters produced by the collision of a meteorite with the Earth (or another planet or moon) are called impact craters. Whereas crater formed during volcanic eruption is known as volcanic crater.

Statement 2 is correct: A crater is not the same thing as a caldera. Craters are formed by the outward explosion of rocks and other materials from a volcano. Calderas are formed by the inward collapse of a volcano's magma chamber. **Craters are usually much smaller features than calderas,** and calderas are sometimes considered giant craters.

Statement 3 is correct: Lakes are **formed when craters and calderas fill with water.** The crater is basically a **circular depression formed** on the land due to volcanic eruptions and activities. **Lonar lake of Maharashtra is a crater lake.** Lonar Lake lies within the only known extraterrestrial impact crater **found within the great Deccan Traps**, a huge basaltic formation in India. The lake was initially believed to be of volcanic origin, but now it is recognized as an impact crater. Lonar Lake was **created by the impact of either a comet or of an asteroid** (extra-terrestrial body).

29. Solution: (a)

Exp) Option a is the correct answer.

A volcano is a **vent or fissure in Earth's crust** through which **lava, ash, rocks, and gases erupt.** An **active volcano is a volcano that has erupted in the recent past.** Material that flows to or reaches the ground comprises lava flows, volcanic bombs, pyroclastic debris, dust, gases etc.

Statement 1 is correct: Volcanoes are located in a fairly clearly defined pattern around the world, **closely related to regions that have been intensely folded or faulted.** They occur **along coastal mountain ranges, offshore islands and in the midst of oceans** but there are few in the **interiors of the continents.**

Statement 2 is correct: In the central parts of the Atlantic Ocean volcanoes are found almost parallel to the coastlines. It further extends into the Indian Ocean. It bifurcates a little south of the Indian subcontinent with one branch moving into East Africa and the other meeting a similar line from Myanmar to New Guiana. **Also, their presence coincides with the mid- oceanic ridges.**

Statement 3 is incorrect: The greatest **concentration is probably that in the Circum-Pacific region (and not in Indian ocean region)**, popularly termed the **'Pacific Ring of Fire'**, which has been estimated to include two-thirds of the world's volcanoes.

30. Solution: (a)

Exp) Option a is the correct answer

Pelean eruptions are named after the 1902 eruption of Mount Pelée in Martinique Island, which destroyed the town of Saint-Pierre and killed more than 30,000 people.

Statement 1 is correct: Formation of lava domes is a characteristic of Pelean eruptions. A lava dome is a steep-sided mound that forms when viscous lava is extruded from a volcanic vent and piles up around the vent. The lava is too viscous to flow far, so it accumulates near the vent, forming a dome-like shape. In Pelean eruptions, the initial phases are characterized by pyroclastic flows and the tephra deposits have lower volume and range than the corresponding Plinian and Vulcanian eruptions. The viscous magma then forms a steep-sided dome or volcanic spine in the volcano's vent. The dome may later collapse, resulting in flows of ash and hot blocks.

Statement 2 is incorrect: Pelean eruptions are characterized by the collapse of a volcano's eruption column and the release of hot, fast-moving pyroclastic flows. **These pyroclastic flows can be extremely dangerous and destructive, and they are often associated with the collapse of the dome or flank of a stratovolcano.** This is because stratovolcanoes are typically made up of hardened lava, ash, and other debris that can create unstable slopes prone to collapse during an eruption.

31. Solution: (a)

Exp) Option a is the correct answer

Active volcanoes are those which have a recent history of eruptions and are likely to erupt again. Dormant volcanoes have not erupted for a very long time but may erupt at a future time. Extinct volcanoes are not expected to erupt in the future.

Option 1 is correct: Barren Island is located in the Andaman Sea, about 140 kilometers (87 miles) northeast of Port Blair, the capital city of the Andaman and Nicobar Islands, which are territories of India. **Barren Island is considered an active volcano because it has erupted multiple times in the past, with the most recent eruption occurring in 2018.** Since the 1780s, Barren Island has erupted at least ten times.

Option 2 is correct: Mauna Loa is a large shield volcano located on the Big Island of Hawaii, in the United States. **It is one of the most active volcanoes on Earth, with its last eruption occurring in 1984.**

Option 3 is incorrect: Mount Kilimanjaro is the highest mountain in Africa, located in Tanzania, and it is actually a dormant stratovolcano that has three distinct cones - Kibo, Mawenzi, and Shira. The last eruption of Mount Kilimanjaro is believed to have occurred between 150,000 and 200,000 years ago, and since then, the volcano has been quiet.

Option 4 is incorrect: Mauna Kea is a shield volcano located on the Big Island of Hawaii. Shield volcanoes are characterized by their gentle slopes and large size, and they are typically formed by repeated eruptions of lava flows. Mauna Kea is one of the tallest mountains in the world. **Mauna Kea last erupted about 4,500 years ago. It is considered a dormant volcano.**

Option 5 is correct: Mount Etna is an active volcano located on the east coast of the island of Sicily in Italy. **It is one of the most active volcanoes in the world and has been erupting for millions of years,** with its most recent eruption occurring in February 2021. Mount Etna is a stratovolcano that is characterized by its frequent explosive eruptions, lava flows, and ash emissions. The volcano has a long history of eruptions, with its first well-documented eruption occurring around 1500 BCE.

32. Solution: (b)

Exp) Option b is the correct answer.

Option a is incorrect: Molten rock that flows out of a volcano is called Lava and it is extremely hot with temperatures between 1000 - 2000 degree Celsius.

Option b is correct: Lahar is an Indonesian term that describes a hot or cold mixture of water and rock fragments that flows down the slopes of a volcano and typically enters a river valley. They are basically **mudflow of volcanic debris** formed as a result of heavy rain on loose ash material and other volcanic debris. Lahars generally occur on or near **stratovolcanoes**, such as those of the Aleutian volcanic arc in Alaska

Option c is incorrect: A mixture of pulverised rock, ash and gases is a type of explosive volcanic hazard called **pyroclastic density currents**. They can move up to 100 Km/hour and occur when magma interacts explosively with water.

Option c is incorrect: Volcanic fallout consisting of fragmented rocks is termed Tephra. The particles range from a few metres to microns in size. They are hazardous to agriculture.

33. Solution: (a)

Exp) option a is the correct answer

An earthquake is shaking or trembling of the earth's surface, caused by the seismic waves or earthquake waves that are generated due to a sudden movement (sudden release of energy) in the earth

Statement 1 is incorrect: The **point where the energy is released is called the focus (not the epicenter)** or the hypocenter of an earthquake.

Statement 2 is incorrect: The **point on the surface directly above the focus is called the epicenter (not the focus).** It is the first surface point to experience earthquake waves. The waves are felt most strongly at the epicentre, becoming less strong as they travel further away.

Statement 3 is correct: The energy radiates outward from the fault in all directions in the form of seismic waves like ripples on a **pond. The seismic waves spreading out from the focus shake the earth as they move through it,** and when the waves reach the earth's surface, they shake the ground and anything on it.

34. Solution: (a)

Exp) Option a is the correct answer.

The distribution of the earthquakes around the world follows a certain pattern as they occur around tectonic plates.

Statement 1 is correct: Earth's **major earthquakes occur mainly in belts coinciding with the margins of tectonic plates.** The **most important earthquake belt is the Circum-Pacific Belt**, which affects many populated coastal regions around the Pacific Ocean—for example, those of New Zealand, New Guinea, Japan, the Aleutian Islands, Alaska, and the western coasts of North and South America.

Statement 2 is incorrect: The **seismic activity is not uniform throughout the Circum-Pacific Belt, and there are many branches at various points.** It is so because at many places the Circum-Pacific Belt is associated with volcanic activity, it has been popularly dubbed the "Pacific Ring of Fire."

Statement 3 is incorrect: The Circum-Pacific Belt accounts for **more than two third of all earthquakes. Alpine-Himalayan belt** is responsible for only **15-17 per cent of the earthquakes in the world.**

35. Solution: (d)

Exp) Option d is the correct answer.

The damage caused by earthquakes is from ground shaking, ground rupture, landslides, fires, tsunamis, and soil liquefaction.

Option 1 is correct: A **large number of tsunamis are a result of earthquakes.** When an **earthquake occurs, the ground shakes, and the movement moves up or down. As a result, the water gets displaced,** and it starts moving randomly in all directions and ends up disturbing the ocean's surface. The displaced water tries to recover equilibrium, but it creates waves because of the gravitational pull. These waves can eventually become destructive and result in a natural disaster.

Option 2 is correct: Strong earthquake ground shaking greatly increases the likelihood of landslides where landscape is susceptible to these types of ground failure. If the ground is saturated with water, particularly following heavy rainfall, the shaking will result in more landslides than normal.

Option 3 is correct: Earthquake damage facts show that fires caused by earthquakes are the second most common hazard. Earthquake fires start when electrical and gas lines are dislodged due to the earth's shaking. **Fires are often caused by broken or damaged lines that cause a spark after coming into contact with flammable** substances or structures.

Option 4 is correct: Liquefaction takes place when loosely packed, water-logged sediments at or near the ground surface lose their strength in response to strong ground shaking. Liquefaction occurring beneath buildings and other structures can cause major damage during earthquakes.

36. Solution: (b)

Exp) Option b is the correct answer.

Tsunami is a Japanese word for "Harbour wave". A tsunami is a series of very long-wavelength waves in large water bodies like seas or large lakes caused by a major disturbance above

or below the water surface or due to the displacement of a large volume of water.

Statement 1 is correct: Submarine landslides are a broad term for indicating the phenomena of failure of near-seabed sediments under the effect of gravity. **During a submarine landslide, the equilibrium sea-level is altered by sediment moving along the floor of the sea. Gravitational forces then propagate a tsunami.** Tsunamis can be generated when a landslide displaces the water from above (subaerial) or below (submarine).

Statement 2 is correct: As a **tsunami leaves deep waters of an ocean or sea and then propagates into the shallow waters, it transforms. This is because as the depth of the water decreases, the speed of the tsunami reduces**. With the decrease in speed, the height of the tsunami wave grows as the total energy of the tsunami remains constant and the amplitude of the wave increases as the wavelength decreases.

Statement 3 is incorrect: Though the Tsunamis are also commonly referred to as tidal waves because of their wavelengths, but **the attractions of the Moon and Sun play no role in their formation**.

37. Solution: (d)

Exp) Option d is the correct answer.

Magnitude is popularly used as a shorthand measure of earthquake size and severity.

Statement 1 is incorrect: The **Richter scale (and not Mercalli scale) describes the earthquake's magnitude by measuring the seismic waves** that cause the earthquake by an instrument called seismograph. The **Richter scale is logarithmic. i.e., a magnitude 5 earthquake is ten times as intense as a magnitude 4 earthquake.**

Statement 2 is incorrect: The **Modified Mercalli Intensity (MMI) scale is a scale used for measuring the intensity of an earthquake and not Richter scale.** It **measures the effects of an earthquake and based on observed effects., and is distinct from the moment magnitude usually reported for an earthquake** (sometimes misreported as the Richter magnitude), which is a measure of the energy released. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally - total destruction.

38. Solution: (c)

Exp) Option c is the correct answer.

The elastic rebound theory was given by Harry Fielding Reid explaining earthquakes.

Option a is incorrect: The **emergence of lava would more appropriately be explained by volcanoes** and not earthquakes.

Option b is incorrect: Earth's inner core is the innermost geological layer of planet Earth. It is primarily **a solid ball** and thus **no question of it having elasticity** rises.

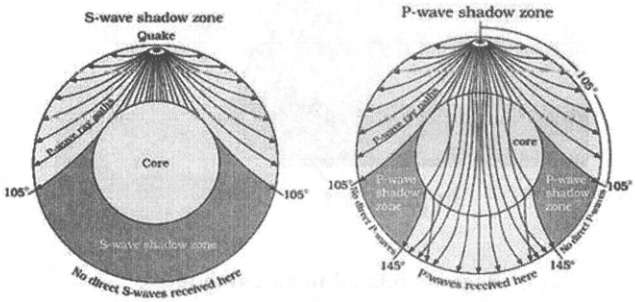
Option c is correct: The **elastic rebound theory is an explanation for how energy is spread during earthquakes.** As **rocks on opposite sides of a fault are subjected to force and shift, they accumulate energy and slowly deform until their internal strength is exceeded. At that time, a sudden movement occurs along the fault, releasing the accumulated energy**, and the rocks snap back to their original undeformed shape. If a stretched rubber band is broken or cut, elastic energy stored in the rubber band during the stretching will suddenly be released. Similarly, **the crust of the earth can gradually store elastic stress that is released suddenly during an earthquake.** In geology, the elastic rebound theory was the first theory to satisfactorily explain earthquakes. Previously it was thought that ruptures of the surface were the result of strong ground shaking.

Option d is incorrect: Earthquakes are ruptures of the surface as the **result of strong ground shaking was a previous theory explaining earthquakes.** Elastic rebound theory proves otherwise.

39. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: The shadow zone of S-waves is larger than that of P-waves. The shadow zone is an area on Earth's surface where seismic waves are not detected. Since S-waves cannot pass through the liquid outer core, it has a more extensive shadow zone.



Statement 2 is incorrect: S-waves can propagate only through the solid mediums. On the other hand, The P-waves **resemble the sound waves** as they **can travel through all the mediums- solid, liquid and gases** Since the outer core is in liquid form, S-waves cannot traverse through this layer, leading to a larger shadow zone.

40. Solution: (d)

Exp) Option d is the correct answer.

Volcanic activity is a manifestation of the dynamic processes occurring within the Earth, primarily driven by the movement of tectonic plates and the associated release of pressure and heat. Volcanoes can take various forms, ranging from stratovolcanoes with steep slopes to shield volcanoes characterized by gentle slopes.

Pair 1 is incorrectly matched: Mount Etna is located on the east coast of the island of Sicily, Italy. It is one of the most active volcanoes in the world and the **highest and most prominent in Europe.** Etna is known for frequent eruptions and the presence of multiple crater landscapes.

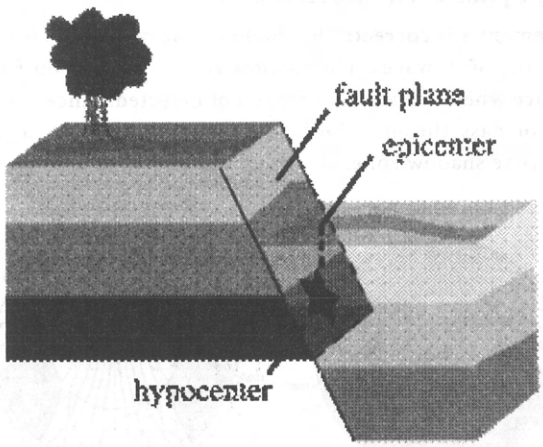
Pair 2 is incorrectly matched: Mount Kilimanjaro is situated in Tanzania, East Africa. Kilimanjaro is the highest mountain in Africa and is a **stratovolcano** that comprises three cones: Kibo, Mawenzi, and Shira. It is **unique for its ice cap**, despite being near the equator.

Pair 3 is incorrectly matched: Mount Cotopaxi is located in the Andes Mountains of Ecuador. Cotopaxi is one of the highest active volcanoes in the world. It has a **symmetric cone and is known for its frequent eruptions.** Cotopaxi **is part of the Pacific Ring of Fire,** an area with a high level of tectonic activity.

41. Solution: (a)

Exp) Option a is the correct answer.

The study of earthquakes involves key terminologies to describe different facets of seismic events. These help in explaining the point of origin of earthquake, points on the surface to experience the waves, and the point where movement in rocks have taken place.



Regions related to an Earthquake

Pair 1 is incorrectly matched: Epicenter is the location where seismic waves, generated by the release of energy within the Earth, **first reach the surface**. It lies directly above the surface of the Earth. Also, it is the point where the earthquake's effects are most strongly felt.

Pair 2 is incorrectly matched: Hypocenter is also called 'focus' of the earthquake. It is the **precise point within the Earth where an earthquake originates, and seismic energy is initially released.**

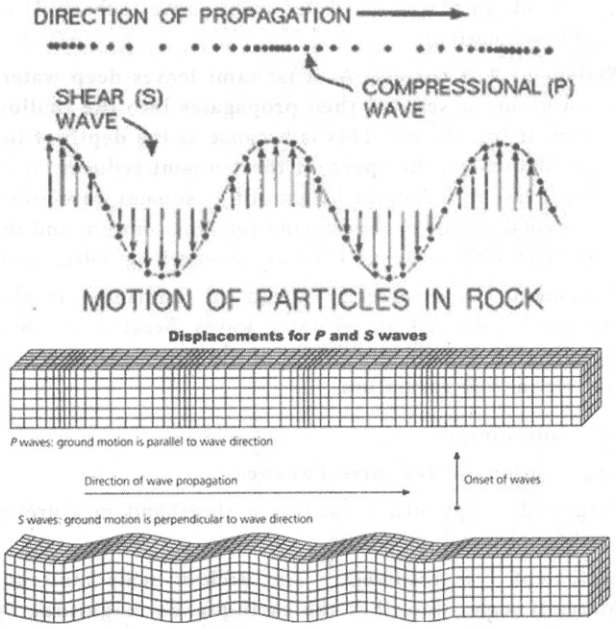
Pair 3 is correctly matched: Fault plane refers to the surface within the Earth along which the **rocks experience movement during an earthquake**. It is the location where **two rocks slip past each other.** This leads to sudden release of energy.

42. Solution: (c)

Exp) Option c is the correct answer.

The Primary waves (P-waves) and Secondary Waves (S-waves) are the sub-types of body waves. During an earthquake, these waves **pass within the interiors** of the earth. When the body waves interact with the surface rocks and generate a new set of waves called surface waves.

Statement 1 is correct: The **P-wave leads to stretching and squeezing of materials, whereas S-waves create troughs and crests in the materials.** P-waves, while vibrating parallel to the direction of waves, create pressure on materials. This creates density differences, leading to stretching and squeezing of materials. On the other hand, due to perpendicular vibration of S-waves, they are known to create troughs and crests in the material.



Statement 2 is incorrect: The manner of propagation of different waves is quite different. The **P-waves vibrate parallel to the direction of waves, whereas the S-waves vibrate perpendicular to the direction of waves.** Hence, the statement given is incorrect.

43. Solution: (b)

Exp) Option b is the correct answer.

The Richter scale, also known as the Richter magnitude scale, was developed by Charles Francis Richter in collaboration with Beno Gutenberg and presented in Richter's landmark 1935 paper.

Statement 1 is correct: The Richter scale measures the **magnitude of an earthquake**, which is related to the energy released during the quake. The Richter scale is logarithmic, and each whole number increase on the scale represents a tenfold increase in the earthquake's magnitude and a thirtyfold increase in the energy released.

Statement 2 is correct: The Richter scale is **expressed in absolute numbers, typically from 0 upwards.** However, **there is no upper limit to the logarithmic Richter scale.** This means that each one-point increase on the scale represents a 10-fold increase in the magnitude of the quake. However, in practice, no earthquake has ever been registered on the scale above magnitude 8.6. That was the magnitude of the Richter for the Chile earthquake of 1960.

Statement 3 is incorrect: The Richter scale **does not consider the visible damage (Visible damage refers to the physical**

signs of destruction that can be seen with the naked eye after an earthquake). That is often assessed using other scales like the **Mercalli intensity scale.** Unlike the Richter scale, the Mercalli scale directly categorizes the **strength of shaking** and its **impact on the environment and human surroundings**. The intensity scale is named after Mercalli, an Italian seismologist. The intensity scale considers the visible damage caused by the event. The range of intensity scale is from 1-12.

Important Tips

1) **Magnitude of Earthquake**: Magnitude is the size and energy released at the source of an earthquake. It is measured on Richter Scale
2) **Intensity of Earthquake**: It refers to the effects of an earthquake at specific locations, describing the level of shaking and resulting changes. **The Mercalli scale** is commonly used to measure intensity of an earthquake. Intensity varies at different locations, even for earthquakes of same magnitude, due to factors such as distance from epicenter, local geology and building structures.

44. Solution: (b)

Exp) Option b is the correct answer.

A volcano is a place where gases, ash, and/or molten rock material, known as lava, are expelled onto the Earth's surface. There are approximately 13500 potentially active volcanoes globally. During eruptions, volcanoes can expel hot, hazardous gasses, ash, lava, and rocks, posing significant risks to human life and property, particularly in densely populated regions.

Statement 1 is correct: Volcanic eruptions, particularly those happening underwater or close to coastlines, have the potential to move substantial amounts of water. **This movement can initiate tsunamis, which are immense ocean waves that travel across the sea.** An example of this occurred in 1883 when the eruption and collapse of the **Krakatau (Krakatoa) volcano** led to one of the most extensive and devastating tsunamis on record.

Statement 2 is incorrect: A volcanic eruption releases Sulphur into the atmosphere, which in turn could block the sun's radiation and cool the earth's surface. Further Volcanic ash and aerosols ejected during eruptions can block sunlight, causing a cooling effect on the Earth's surface. This phenomenon can lead to lower temperatures in the atmosphere for days, weeks, or even months after the eruption.

Statement 3 is correct: Ozone layer destruction can be caused due the introduction of chemicals such as volcanic aerosol particles (or human made CFCs). Volcanic aerosols can damage the ozone layer by providing a surface for chemical reactions to take place. The aerosols increase the effectiveness of chlorine ions at destroying the ozone layer.

Important Tips

Mercury can be released into the environment through natural processes like volcanic eruptions.

Volcanic eruptions can release mercury vapor, which is harmful when inhaled. It enters the bloodstream and damages the nervous system, affecting memory, learning, and coordination. Pregnant women exposed to Mercury can pass it to their babies, impacting brain development.

45. Solution: (a)

Exp) Option a is the correct answer.

A **volcano** is an opening in the Earth's crust that allows **molten rocks and gases** to escape. Volcanic activities are **associated with crustal disturbances**, particularly where there are **zones of weakness due to deep faulting or folding of mountains.** There are **more than 1350 active volcanoes and thousands of dormant and extinct volcanoes.** They may occur at **coastal mountain ranges, offshore islands, and in the oceans**. Apart from this, a few volcanoes also occur at **the interiors of the continents.**

Statement-I is correct: The Circum-Pacific Belt, also known as the Pacific Ring of Fire, is an area around the Pacific Ocean characterized by a **high level of seismic and volcanic activity**. This belt is **home to more than 2/3rd of the world's volcanoes**, making it a significant hotspot for volcanic activity. Several tectonic plates responsible for this formation are the **Pacific, Juan de Fuca, Cocos, Indian-Australian, Nazca, North American,** and **Philippine Plates.**

Statement-II is correct: The Circum Pacific Belt is associated with the **convergence of several tectonic plates.** In particular, the **Pacific Plate**, which is an oceanic plate, is surrounded by several continental plates. **When an oceanic plate collides with a continental plate, the denser oceanic plate is forced beneath the lighter continental plate in a process called subduction**. This subduction process creates deep ocean trenches and can lead to the **formation of volcanic arcs along the continental margins.** These volcanic arcs are responsible for most of the volcanic activity observed within the Circum-Pacific Belt. **Hence, statement-II correctly explains the reason for the assertion given in statement-I.**

46. Solution: (b)

Exp) Option b is the correct answer.

Lakes are formed due to various geological processes, including tectonic movements, volcanic activity, meteorite impacts, and glacial movements. Among them, **caldera lakes** are a specific type that form when a volcano collapses after a massive eruption, creating a large depression that later fills with water. These lakes are often associated with past volcanic activity and can have unique ecological and geological features.

Option 1 is correct. Lake Toba is one of the **largest volcanic lakes in the world**, formed after a **supervolcanic eruption** approximately **74,000 years ago**. The eruption led to the collapse of the volcano, creating a massive **caldera**, which eventually filled with water. It is one of the most studied

caldera lakes due to its geological importance and the theory that the eruption caused a global climate change event.

Option 2 is incorrect. Unlike caldera lakes, Lonar Lake in Maharashtra, India, was formed due to a **meteorite impact** around **52,000 to 576,000 years ago. It is classified as a meteorite impact crater lake rather than a volcanic caldera lake.**

Option 3 is correct. Lake Nyos is a **volcanic crater lake** in Cameroon, located above a dormant volcano. Though it is not formed by a large-scale volcanic collapse, it is still **a caldera lake** due to its volcanic origins. It is infamous for the **1986 limnic eruption**, where a sudden release of **carbon dioxide (CO_2)** suffocated nearby villages, leading to thousands of deaths.

Option 4 is incorrect. Beaver Lake, USA is a 67-acre manmade lake. Animals like beavers live in communities and construct dams across the rivers with timber. Such beaver dams are quite permanent and are found in North America eg. Beaver Lake in Yellowstone National Park, USA. **It is not an example of caldera/crater lakes of volcanic origin.**

47. Solution: (c)

Exp) Option c is the correct answer.

Statement I is correct. Basic lava are the hottest lavas. About 1000° C and are **highly fluid. Acidic Lava are highly viscous with a high melting point.**

Statement II is correct. Acidic lava is **light colored and has low density**. They **have a high percentage of silica**. They flow slowly and seldom travel far before solidifying. Whereas, Basic lava are dark colored like ***basalt*** rich in iron and magnesium but poor in silica.

Statement III is incorrect. Acidic lava typically has a **higher melting point compared to basic lava.** Higher silica content in acidic lava requires more energy to break the strong silicate bonds, leading to a higher melting point than basic lava.

Statement-II is the correct explanation for Statement-I : Acidic lava has a higher silica content than basic lava. The higher silica content of acidic lava makes it more viscous. Silica is a compound that increases the resistance to flow in lava, thus making acidic lava thicker and slower to move.

48. Solution: (d)

Exp) Option d is the correct answer.

A volcano is an opening on the surface of a planet or moon that allows material warmer than its surroundings to escape from its interior. The release of the material causes an eruption.

Options 1 and 4 are correct: The material in the upper mantle portion of the Earth is called magma. Once it starts moving towards the crust or it reaches the surface, it is referred to as lava. The material that reaches the ground includes lava flows, pyroclastic debris, volcanic bombs, ash and dust and gases such as nitrogen compounds, sulphur compounds and **minor amounts of chlorine,** hydrogen and **argon.**

Options 2 and 3 are correct: Ninety-nine per cent of the gas molecules emitted during a volcanic eruption are water vapour (H2O), carbon dioxide (CO2) and sulfur dioxide (SO2). The remaining one per cent is composed of small amounts of hydrogen sulfide, **carbon monoxide,** hydrogen chloride, **hydrogen fluoride,** etc.

49. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Dykes are geological formations that are typically **vertical or near-vertical**. They are formed when **magma forces its way into fractures (cracks) or fissures in the Earth's crust and solidifies**. These formations typically appear as **wall-like features**, standing almost **perpendicular to the ground**. These structures are **intrusive volcanic landforms**, and are commonly found in areas like **western Maharashtra**.

Statement 2 is correct: Dykes in Maharashtra (specifically western Maharashtra)**, served as feeders for the volcanic eruptions that led to the formation of the Deccan Traps.**

- Dykes served as pathways or channels for magma during volcanic eruptions.
- During the **late Cretaceous period**, these dykes acted as **feeders or channels** for the **magma,** transporting it from deep within the Earth to the surface.
- The magma erupted through these volcanic pathways as **basaltic lava**, which then spread over large areas and solidified into extensive layers.
- This repeated process eventually led to the **development** of the vast **basaltic plateau** known as the **Deccan Traps.**

50. Solution: (a)

Exp) Option a is the correct answer.

A volcano is a vent or fissure in the crust of a planetary-mass object, such as Earth where gases, ashes and/or molten rock material – lava – escape to the ground. Volcanoes are classified based on the nature of eruption and the form developed at the surface.

Row 1 is incorrect: Shield volcanoes are mostly made up of basalt, a type of lava that is very fluid when erupted. For this reason, these **volcanoes are not steep.** They become explosive if somehow water gets into the vent; otherwise, they are characterised by low explosivity. The upcoming lava moves in the form of a fountain and throws out the cone at the top of the vent and **develops into a cinder cone. Barring the basalt flows, the shield volcanoes are the largest of all the volcanoes** on the earth. **The Hawaiian volcanoes are the most famous examples.**

Row 2 is correct: Caldera are the most explosive of the earth's volcanoes. They are usually so explosive that when they erupt they tend to collapse on themselves rather than building any tall structure. The collapsed depressions are called calderas. Their explosiveness indicates that the magma chamber supplying the lava is not only huge but is also in close vicinity. **The example of a caldera type volcano includes Crater Lake, in the U.S. state of Oregon.**

Row 3 is incorrect: Composite volcanoes are characterised by **eruptions of cooler and more viscous lavas than basalt.** These volcanoes often result in explosive eruptions. Along with lava, large quantities of pyroclastic material and ashes find their way to the ground. This material accumulates in the vicinity of the vent openings leading to the formation of layers, and this makes the mounts appear as composite volcanoes. **Mount Fuji in Japan** and Mount Shasta in California **are examples of composite volcanoes.**

51. Solution: (a)

Exp) Option a is the correct answer.

The **hypocentre**, also known as the focus of an earthquake, **is the point within the Earth's crust where the energy is first released during an earthquake**. This release occurs due to the sudden movement or slipping of rocks along a fault line, overcoming the friction that previously locked them in place. The released energy propagates as seismic waves in all directions from the hypocentre.

The epicentre is different from the hypocentre—it is the point on the Earth's surface directly above the hypocentre and is the first location on the surface to experience the seismic waves.

52. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: All natural **earthquakes take place in the lithosphere**. The lithosphere is the outermost solid layer of the Earth, comprising the crust and the uppermost part of the mantle. Earthquakes occur due to the movement of tectonic plates in the lithosphere.

Statement 2 is correct: The energy **released during an earthquake is measured using the Richter scale or the moment magnitude scale.**

The Mercalli scale measures the intensity of an earthquake, which is a subjective measure of the earthquake's effects on the Earth's surface, people, and structures.

53. Solution: (c)

Exp) Option c is the correct answer.

Volcanic rocks, also known as **extrusive igneous rocks**, are formed when molten magma erupts from a volcano and cools rapidly on the Earth's surface. Due to their quick solidification, these rocks typically have **small or fine-grained crystals.**

Statement 1 is incorrect: Volcanic rocks **do not form at depth** in the Earth's crust. Instead, they form on the **Earth's surface** when molten lava cools and solidifies rapidly. Rocks that form **at depth** are called **plutonic (intrusive) rocks** (e.g., granite).

Statement 2 is correct: Volcanic rocks **solidify faster than plutonic rocks** because they cool rapidly when exposed to the surface atmosphere, preventing large crystal formation.

Statement 3 is correct: **Basalt** is a common volcanic (extrusive) rock, forming **lava flows, sheets, and plateaus**, such as the **Deccan Plateau in India** and the **Columbia Plateau in the U.S.A.**

54. Solution: (b)

Exp) Option b is the correct answer.

During an earthquake, the body waves are produced that travel through the Earth's interior, radiating outward from the focus. They are classified into two types: P waves (primary or compression waves) and S waves (secondary or shear waves). Upon reaching the Earth's surface, a portion of their energy converts into surface waves, which are further categorized into Love waves and Rayleigh waves.

Statement 1 is incorrect: The Love waves(L-waves) move on the **ground horizontally from side to side.** Rayleigh waves(R-waves) are significantly bigger than Love waves and they move on the Earth up and down as well as side to side in the same direction as the wave.

Statement 2 is correct: Love Waves travel faster than Rayleigh Waves, making them the fastest surface waves.

55. Solution: (a)

Exp) Option a is the correct answer.

Seismic waves are caused by the sudden movement of materials within the Earth, such as slip along a fault during an earthquake.

Statement 1 is correct: P-waves, also known as primary waves or pressure waves, travel at the greatest velocity through the Earth. When they travel through air, they take the form of sound waves – compressing and expanding the medium. Because of their speed, they are the **first waves to be recorded by a seismograph during an earthquake.**

Statement 2 is correct: S-waves are also known as secondary waves, shear waves or shaking waves. They are transverse waves that travel about 1.7 times slower than P waves. In this case, particle motion is perpendicular to the direction of wave propagation. **S-waves cannot travel through air or water but are more destructive than P-waves because of their larger amplitudes.** S waves produce vertical and horizontal motion in the ground surface.

Statement 3 is incorrect: Rayleigh waves, also called ground roll, travel as ripples similar to those on the surface of water. They move in an elliptical motion, producing both a vertical and horizontal component of motion in the direction of wave propagation.

Statement 4 is incorrect: Love waves cause horizontal shearing of the ground. **Love waves (4.4 km/s) usually travel slightly faster than Rayleigh waves (3.5 km/s).** They move parallel to the Earth's surface and perpendicular to the direction of wave propagation.

Important Tips

In the Earth, P waves travel at speeds from about 6 km per second in surface rock to about 10.4 km per second near the Earth's core some 2,900 km below the surface. As the waves enter the core, the velocity drops to about 8 km per second.

Love waves and Rayleigh waves are called surface waves. Surface waves are typically generated when the source of the earthquake is close to the Earth's surface. Although surface waves travel more slowly than S-waves, they can be much larger in amplitude and can be the most destructive type of seismic wave.

2.3. Minerals and Rock Systems

56. Solution: (c)

Exp) Option c is the correct answer.

Igneous rocks (from the Latin word for fire) form when hot, molten rock crystallizes and solidifies. The melt originates deep within the Earth near active plate boundaries or hot spots, then rises toward the surface. They are normally crystalline in structure and do not occur in strata (layers). Due to extreme temperature during formation, they are devoid of any fossils.

Igneous rocks may be sub-divided based on mineral composition. When they contain a high proportion of silica, they are said to be acid.

In terms of origin there are two main classes of igneous rocks:

1. Plutonic rocks. These are igneous rocks, formed at some depth in the earth s crust. They have cooled and solidified slowly so that large, easily recognized crystals have been able to form.
2. Volcanic rocks. These are molten rocks poured out of volcanoes as lavas. They solidify rapidly on the earth's surface and the crystals are small.

Option a is incorrect: Sedimentary' rocks are formed from sediment accumulated over long periods, usually under water. They are distinguished from the other rock types in their characteristic layer formation and are termed stratified rocks.

Option b is incorrect: Metamorphic rocks form when rocks are subjected to high heat, high pressure, hot mineral-rich fluids or, more commonly, some combination of these factors.

Option d is incorrect: Calcareous rocks are a type of sedimentary rocks formed from a variety of chemical and detrital sediments such as limestone, and dolostone.

57. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct- Sedimentary rocks are properly stratified (exist as layers) in different rock beds and are great source of fossil fuels. They **do not have any crystalline structure** as those of igneous rocks. Thus, they are stratified and non-crystalline.

Statement 2 is *incorrect*- Igneous rocks **contains no or very less fossils** because of its formation from the hot molten magma.

It is sedimentary rocks which contains large quantity of fossils.

Statement 3 is *incorrect*-Limestone is type of sedimentary rock which is formed organically. Limestone converts into marble under heat and pressure. The marble thus formed is a metamorphic rock.

58. Solution: (b)

Exp) Option b is the correct answer.

The word metamorphic means 'change of form'. These rocks form under the action of pressure, volume and temperature (PVT) changes.

Statement 1 is correct: Metamorphism occurs when rocks are forced down to lower levels of the Earth by tectonic processes or when molten magma rising through the crust comes in contact with the crustal rocks or the underlying rocks are subjected to great amounts of pressure by overlying rocks. **Metamorphism is a process by which already consolidated rocks undergo recrystallisation and reorganisation of materials within original rocks.**

Statement 2 is correct: **In the process of metamorphism in some rocks grains or minerals get arranged in layers or lines. Such an arrangement of minerals or grains in metamorphic rocks is called foliation or lineation.**

Statement 3 is correct: Some of the well-known examples of metamorphosed rocks are as follows: clay may be metamorphosed into **slate**, limestone into **marble**, sandstone into **quartzite**, granite into **gneiss**, shale into **schist** and coal into **graphite.**

59. Solution: (b)

Exp) Option b is the correct answer.

Weathering is defined as **mechanical disintegration and chemical decomposition** of rocks through the actions of various elements of weather and climate. **Weathering** occurs one of three ways: through **physical processes** or through **chemical processes** or through biological activity.

Statement 1 is incorrect: Chemical weathering typically increases as temperatures rise with rain. Thus, **rocks in hot and wet climates experience faster rates of chemical weathering than do rocks in cold, dry climates**. Wet climates accelerate the rates of chemical weathering, caused when C02 in dirt mixes with air and water to form a weak acid. The weak acid breaks down rocks more rapidly in wet climates compared with dry ones.

Statement 2 is incorrect: Biological weathering occurs when living organisms break up rocks. Tree roots, for example, can fracture rocks in the same way they buckle pavement. Warm, humid climates are most favourable to life. The rates of biological weathering are most **rapid in warm humid climates** like those in tropical regions and not in desert ecosystem due lack of wet conditions.

Statement 3 is correct: Certain types of rocks are more vulnerable to different types of weathering, while others are more stable. **Calcite is a type of rock that weathers quickly, due to the fact that it is rich in calcium**. Rocks containing

iron and magnesium also tend to weather rapidly, while quartz is a stable type of rock.

60. Solution: (a)

Exp) Option a is the correct answer.

Sedimentary rocks are formed from pre-existing rocks or pieces of once-living organisms. They form from deposits that accumulate on the Earth's surface. Sedimentary rocks often have distinctive layering or bedding.

Option 1 is correct: Conglomerate is a clastic sedimentary rock that contains large (greater than two millimeters in diameter) rounded particles. The space between the pebbles is generally filled with smaller particles and/or a chemical cement that binds the rock together.

Option 2 is correct: Coquina is a type of limestone composed of calcium carbonate shells, shell fragments, and other sand-sized fossil debris. It forms in the shallow waters of coastal areas with a tropical or subtropical climate. The particles are weakly cemented together, and therefore coquina is a very porous material that can function as an aquifer or a reservoir for oil and natural gas.

Option 3 is incorrect: Andesite is a fine-grained, extrusive igneous rock composed mainly of plagioclase with other minerals such as hornblende, pyroxene, and biotite.

Option 4 is correct: Dolomite (also known as "dolostone" and "dolomite rock") is a chemical sedimentary rock that is very similar to limestone. It is thought to form when limestone or lime mud is modified by magnesium-rich ground water.

Option 5 is incorrect: Gabbro is a coarse-grained, dark-colored, intrusive igneous rock that contains feldspar, pyroxene, and sometimes olivine.

61. Solution: (c)

Exp) Option c is the correct answer.

When magma in its upward movement cools and turns into solid form it is called **igneous rock**. The process of cooling and solidification can happen in the earth's crust or on the surface of the earth. They are also known as primary rocks. Igneous rocks can be divided into groups depending upon the conditions under which they solidify. They are:

1. Extrusive rocks: Extrusive rocks are those rocks which are formed when the magma accumulates and solidifies on the surface of the earth.
2. Intrusive rocks: The rising magma solidifies below the earth's surface during a volcanic activity is called intrusive rocks.

Statement 1 is incorrect: The igneous rocks are generally massive and unstratified. They show distinct signs of having cooled from a high temperature.

Statement 2 is incorrect: Igneous rocks are to be the hardest rocks. **They are not considered as good source of coal and petroleum, because they are not arranged as strata like sedimentary rocks and thus do not contain fossils**. They are resistant to weathering, having fine to coarse grained texture.

Statement 3 is correct: Gabbro is an example of igneous rocks. Nearly all gabbros are found beneath the earth's surface. Granite, pegmatite, basalt, volcanic breccia and tuff are some other examples of igneous rocks.

62. Solution: (c)

Exp) Option c is the correct answer.

Porosity is a measure of the void spaces in a material and Permeability is a measure of the ability of a material to transmit fluids. Porosity and permeability are related properties of any rock or loose sediment. Both are related to the number, size, and connections of openings in the rock.

Statement 1 is correct: The porosity of a rock is a measure of its ability to hold a fluid. it is the open space in a rock divided by the total rock volume. **Permeability is a measure of the ease of flow of a fluid through a porous solid.**

Statement 2 is correct: The surface water percolates well when the rocks are permeable, thinly bedded and highly jointed and cracked. After vertically going down to some depth, the water under the ground flows horizontally.

Statement 3 is incorrect: A rock may be extremely porous, but if the pores are not connected, it will have no permeability.

63. Solution: (b)

Exp) Options b is the correct answer.

Statement 1 is incorrect: Rocks formed out of solidification of magma (molten rock below the surface) and lava (molten rock above the surface) are known as igneous or primary rocks. Based on their origin, igneous rocks are classified into two types:

1. **Plutonic Rocks or (Intrusive igneous rocks):** If magma cools slowly at great depths, mineral grains formed in the rocks may be very large. Such rocks are called intrusive rocks or plutonic rocks. Thus, plutonic rocks are a type of igneous rock (Not formed due to the denudation of igneous rocks).
2. **Volcanic Rocks or (Extrusive igneous rocks):** Sudden cooling of magma just below the surface or lava above the surface results in small and smooth grains in rocks as rapid cooling prevents crystallization, as a result, such rocks are fine-grained. Such rocks are called extrusive rocks or volcanic rocks (e.g. Basalt).

Statement 2 is correct: Granite, gabbro, pegmatite, **basalt,** volcanic breccia and tuff **are some of the examples of igneous rocks.**

64. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Metamorphism occurs when rocks are forced down to lower levels of the Earth by tectonic processes or when molten magma rising through the crust comes in contact with the crustal rocks or the underlying rocks are subjected to great amounts of pressure by overlying rocks. **Metamorphism is a process by which already consolidated rocks undergo recrystallisation and reorganisation of materials within original rocks.**

Statement 2 is correct: In the process of metamorphism in some rocks grains or minerals get arranged in layers or lines. Such an arrangement of minerals or grains in metamorphic rocks is called foliation or lineation.

Statement 3 is correct: Causes of Metamorphism among rocks are:

- **Orogenic (Mountain Building) Movements**: Such movements often take place with an interplay of folding, warping and high temperatures. These processes give existing rocks a new appearance.
- **Lava Inflow:** The molten magmatic material inside the earth's crust brings the surrounding rocks under the influence of intense temperature pressure and causes changes in them.
- **Geodynamic Forces:** The omnipresent geodynamic forces such as plate tectonics also play an important role in metamorphism.

Statement 4 is incorrect: Limestone is type of sedimentary rock which is formed organically. Limestone converts into marble under heat and pressure. The marble thus formed is a metamorphic rock. Some of the well-known examples of metamorphosed rocks are as follows: clay may be metamorphosed into **slate**, limestone into **marble**, sandstone into **quartzite**, granite into **gneiss**, shale into **schist** and coal into **graphite.**

65. Solution: (b)

Exp) Options b is the correct answer.

Statement 1 is correct: Sedimentary rocks are formed through the process of lithification, which is the transformation of loose, unconsolidated sediments into solid rock. This process involves three main stages:

1) **Weathering and Erosion:** The first stage of lithification is weathering and erosion; they break down rocks and minerals into smaller particles called sediments.
2) **Deposition:** At the depositional site, the sediments settle and accumulate. The weight of the overlying sediments compacts the lower layers, squeezing out water and air spaces.
3) **Cementation:** Over time, minerals dissolved in water can precipitate and fill the spaces between the sediment grains. This process, called cementation, further strengthens the rock and completes the lithification process.

Statement 2 is correct: Fossils are predominantly found in sedimentary rock deposits due to favorable conditions for preservation. Sedimentary rocks, formed from accumulating sediments over time, are more likely to preserve the remains of past organisms. **These rocks often originate in environments conducive to organic matter preservation, such as swamps and oceans. Additionally, sedimentary rocks are well-preserved, resisting erosion.** In contrast, igneous and metamorphic rocks, formed through processes that involve melting or recrystallization are less suitable for fossil preservation as these processes obliterate any existing organic matter.

Statement 3 is incorrect: Schist and marble are examples of Metamorphic rocks, not sedimentary rocks. Conglomerate, limestone, shale, loess, geyserite, chalk etc are some examples of Sedimentary rocks.

66. Solution: (c)

Exp) Option c is the correct answer.

Coal is an **organically formed sedimentary rock**. Organically formed sedimentary rocks are formed from the remains of living organisms, such as **leaves, roots, and shells.** Coal is formed when organic matter, usually plants which are **decomposed in a swampy environment**. The decomposition process creates peat, which is 60% rotting material and 40% water. Over time, the peat compacts as new layers of decaying matter build up. When enough water is expelled, the peat forms lignite coal. Additional time and pressure will expel even more water to form bituminous coal.

Coal is mainly composed of carbon and can be burnt as fuel. It is classified into four main types, or ranks: anthracite, bituminous, subbituminous, and lignite. The ranking depends on the types and amounts of carbon the coal contains and on the amount of heat energy the coal can produce.

Important Tips

1) **Mechanically formed sedimentary rocks: They** are typically formed through the physical breakdown and deposition of pre-existing rocks or mineral grains. Examples include **conglomerate and sandstone**.
2) **Chemically formed igneous rock: This is a type of igneous rock formed by the crystallization of magma or lava with a specific chemical composition.** Examples of chemically formed igneous rocks are **basalt, granite, and rhyolite**.
3) **Ancient metamorphic rock: This is a type of metamorphic rock formed by the alteration of pre-existing rocks due to high temperature and pressure over long periods of time.** Examples of ancient metamorphic rocks are **gneiss, schist, and marble.**

67. Solution: (b)

Exp) Option b is the correct answer.

Intrusive igneous landforms, such **as batholith, stock, dykes, sills, phacolith, laccolith, lopolith etc.,** form beneath the Earth's surface through the cooling and solidification of magma. They are characterized by their coarse-grained texture due to slow cooling. On the other hand, **Extrusive igneous landforms**, such as **volcanic cones**, form on the Earth's surface through the eruption and rapid cooling of lava or volcanic materials. They typically exhibit a fine-grained texture due to rapid cooling.

Option b is correct: A **lopolith** is a specific type of intrusive igneous landform distinguished by its unique concave, saucer-shaped structure. These formations develop beneath the Earth's surface when molten rock, known as magma, intrudes between layers of pre-existing rock, typically sedimentary layers. As the magma rises, it encounters resistance from the surrounding rock layers, causing it to

spread out horizontally and create a broad, shallow basin-like shape. Over time, as the magma cools and solidifies, it forms the characteristic bowl-like structure known as a lopolith. Lopoliths are typically found in layered mafic igneous complexes (geological formation of sequentially layered mafic rocks intruded in the Earth's crust). **The Bushveld Lopoliths of South Africa and the Duluth Lopoliths of Minnesota, U.S.A are its major examples.**

Option a is incorrect: Laccoliths are mushroom-shaped intrusions resulting from magma intrusion between layers of sedimentary rock, which causes the overlying rock to rise, forming a dome-shaped structure. Laccoliths have a dome-shaped upper surface and a flat base, fed by a pipe like conduit from below, and they arch up the overlying strata of sedimentary rock, **e.g. Laccoliths of the Henry Mountains, in Utah USA.**

Option c is incorrect: A **phacolith** is a lens-shaped igneous intrusion. Phacoliths are significant sources of minerals and gemstones. They are situated at the crest of an anticline or the bottom of a syncline and are fed by a conduit originating from beneath. E.g.- **Corndon hill in Shropshire, England.**

Option d is incorrect: A **batholith is** a vast body of intrusive igneous rock that forms deep beneath the Earth's surface through the solidification of magma. Typically composed of granite or other coarse-grained rocks, batholiths can extend for hundreds of square kilometers and reach great depths within the Earth's crust. Over time, geological processes such as erosion and uplift gradually expose these massive structures to the surface, often forming prominent mountain ranges or upland regions. **E.g.- Sierra Nevada Batholith, California.**

68. Solution: (c)

Exp) Option c is the correct answer.

Igneous rocks, also known as magmatic rocks, are one of the three main types of rocks, along with sedimentary and metamorphic. The word igneous comes from the Latin word ignis, which means "fire". Igneous rocks form when magma or lava cools and solidifies. Magma is molten rock that originates deep within the Earth near active plate boundaries or hot spots.

Igneous rocks can form either at volcanoes on the surface of the Earth or while the melted rock is still inside the crust. For example, granite forms deep inside the Earth under a mountain or volcano when melted rock cools or crystallizes into solid rock.

Statement 1 is correct: Plutonic rocks typically have **larger grain sizes than volcanic rocks due to the conditions under which they are formed.** Plutonic rocks, also known as intrusive igneous rocks, are **formed from magma that cools slowly beneath the Earth's surface.** The **slow cooling allows sufficient time for mineral crystals to grow to relatively large sizes.**

In contrast, volcanic rocks, also known as extrusive igneous rocks, are formed from magma that erupts onto the Earth's surface and cools relatively quickly. This rapid cooling doesn't allow much time for mineral crystals to grow, resulting in smaller grain sizes.

Statement 2 is incorrect: Plutonic rocks **solidify more slowly than volcanic rocks. That is the rate of cooling of volcanic rock is faster than plutonic rock.** Because plutonic rocks form beneath the Earth's surface, they are insulated by surrounding rock, which slows down the cooling process. In contrast, volcanic rocks solidify relatively quickly when magma erupts onto the Earth's surface or is extruded from volcanic vents.

69. Solution: (d)

Exp) Option d is the correct answer.

Lapilli, scoria, and pumice are small rocks and materials that are ejected during a volcanic eruption. These materials often land around the volcano and can be found in many volcanic regions.

Lapilli: They are small volcanic stones or fragments that are typically about the size of a pea or a small marble.

Pumice: A light, spongy rock that forms during explosive volcanic eruptions. It has many small holes (vesicles) and is so light that it can float on water. Pumice is usually light-colored and comes from very thick, sticky lava.

Scoria: A dark, spongy rock with lots of vesicles It's formed from lava that cools quickly during an eruption. Scoria is heavier than pumice and is typically found in explosive eruptions of lava that's rich in iron and magnesium.

70. Solution: (c)

Exp) Option c is the correct answer.

Metamorphic rocks are formed when **existing rocks**—whether sedimentary, igneous, or other metamorphic rocks—**undergo a transformation** due to changes in **pressure, volume and temperature** (PVT) over long periods. This process, known as **metamorphism**, leads to changes in the mineral composition, texture, and structure of the original rock. The degree of metamorphism can vary, resulting in different types of metamorphic rocks.

Option 1 is correct: Quartzite is a metamorphic rock formed from sandstone through intense heat and pressure, which causes the quartz grains to fuse together.

Option 2 is correct: Marble is also a metamorphic rock that forms from the recrystallization of limestone or dolomite under heat and pressure, resulting in a rock with a crystalline texture.

Option 3 is correct: Schist is a metamorphic rock formed from shale or other fine-grained sedimentary rocks. It is characterized by its foliated structure, where minerals like mica are aligned.

Option 4 is incorrect: Sandstone is a sedimentary rock composed of sand-sized particles that has not undergone metamorphism.

Option 5 is correct: Slate is a **fine-grained metamorphic rock** formed from shale or mudstone under low-grade metamorphism, known for its ability to split into thin, flat layers.

71. Solution: (c)

Exp) Option c is the correct answer.

Cement is a mixture of **non-metallic minerals.** It primarily consists of limestone (calcium carbonate), clay, sand, and other additives. These minerals are combined and processed to produce a binding agent that hardens when mixed with water, making it a crucial component in construction materials like concrete.

Ferrous minerals: Metallic minerals that contain iron, such as iron ore and magnetite.

Metallic minerals: Minerals that contain metals in their natural form, such as iron, copper, and gold.

72. Solution: (c)

Exp) Option c is the correct answer.

Rocks are classified into **igneous, sedimentary, and metamorphic** types based on their formation process. **Sedimentary rocks** are formed by the accumulation and compression of sediments over time, often in water bodies like rivers, lakes, and oceans.

Option 1 is correct: Coal is an **organic sedimentary rock** formed from the compression of plant material over millions of years. It is rich in **carbon** and is classified based on its carbon content into **peat, lignite, bituminous coal, and anthracite.**

Option 2 is correct: Sandstone is a **clastic sedimentary rock** composed of **sand-sized mineral grains**, mostly **quartz and feldspar.** It forms from the **cementation and compaction of sand particles** over time.

Option 3 is correct: Limestone is a **chemical and organic sedimentary rock** composed mainly of **calcium carbonate** ($CaCO_3$). It forms from the accumulation of marine organisms' shells and skeletons.

Option 4 is correct: Chalk is a **type of limestone**, made from the microscopic remains of marine organisms like **foraminifera and coccolithophores.** It is soft, porous, and white in color.

Option 5 is incorrect: Slate is a **metamorphic rock** that forms from the transformation of **shale** (a sedimentary rock) under **heat and pressure.** It has a fine-grained structure and splits easily into thin sheets.

73. Solution: (a)

Exp) Option a is the correct answer.

A **lacolith** is a type of **igneous intrusion** formed when magma pushes upward between layers of pre-existing rock, but it doesn't break through the surface. Instead, the magma creates a **dome-shaped** structure beneath the surface, with a level base. The magma is typically fed by a conduit from below, causing it to spread horizontally between the rock layers. This intrusion creates a **mound-like** appearance, which is characteristic of lacoliths. Thus, **Lacoliths are large dome-shaped intrusive bodies with a level base and connected by a pipe-like conduit from below.**

Option b is incorrect: Lopolith is a concave-shaped igneous intrusion that forms at a deeper level in the Earth and causes a depression in the surrounding rock layers. Unlike laccoliths, lopoliths are typically saucer-shaped, not dome-shaped.

Option c is incorrect: A Phacolith is a smaller, crescent- or lens-shaped body of igneous rock that is found along the folds (anticlines or synclines) in the Earth's crust. It is typically associated with folding, whereas laccoliths are more about pushing up layers of rock due to magma intrusion.

Option d is incorrect: Batholiths is a large body of magmatic material that cools in the deeper depth of the crust and develops in the form of large domes.

74. Solution: (c)

Exp) Option c is the correct answer.

Igneous rocks, also known as primary rocks, originate from magma and lava from the Earth's interior. They form when magma cools and solidifies, either beneath the Earth's crust or on the surface. This process of cooling and solidification leads to the formation of igneous rocks, shaping the Earth's geological structure.

Statement 1 is incorrect: Igneous rocks do not exhibit a lineated structure.. Lineation is a structural feature associated with **metamorphic rocks in which rocks grains or minerals get arranged in layers or lines.**

Statement 2 is correct: Igneous rocks are crystalline structures. They do not occur in strata nor do they contain fossils (**unfossiliferous).**

Statement 3 is correct: Many igneous rocks, particularly acidic igneous rocks are rich in aluminum (Al), Iron(Fe(, and silica (SiO_2).

Statement 4 is correct: Granite, gabbro, pegmatite, **basalt,** volcanic breccia and tuff **are some of the examples of igneous rocks.**

2.4. CDT, SFS & Plate Tectonic Theory

75. Solution: (d)

Exp) Option d is the correct answer.

Continental drift describes one of the earliest ways geologists thought continents moved over time. Today, the theory of continental drift has been replaced by the science of plate tectonics.

Option a is incorrect: According to Wegener, all the continents formed a single continental mass and mega ocean surrounded the same. The supercontinent was called Pangea which meant all earth. The **mega-ocean was called PANTHALASSA**, meaning all water. He argued that, around 200 million years ago, the super continent, Pangaea, began to split. **Pangaea first broke into two large continental masses as Laurasia and Gondwanaland forming the northern and southern components respectively.** Subsequently, Laurasia and Gondwanaland continued to break into various smaller continents that exist today.

Option b is incorrect: Wegener suggested that the movement responsible for the drifting of the continents was caused by **pole-fleeing force and tidal force**. The polar-fleeing force relates to the rotation of the earth. The second force that was suggested by Wegener—the tidal force—is due

to the attraction of the moon and the sun that develops tides in oceanic waters.

Option c is incorrect: The greatest problem facing Wegeners theory was the lack of direct evidence for the movements of continents (no GPS at the time!) and no mechanism was known to be powerful enough to move entire continents. Wegener proposed gravitational pull, tidal and centrifugal forces, but British geophysicist and astronomer Harold Jeffreys (1891-1989) demonstrated that these forces are much too weak to explain moving continents.

Option d is correct: Rocks of Same Age across the Oceans gave evidence about the drift of the landmasses. The radiometric dating methods developed in the recent period have facilitated correlating the rock formation from different continents across the vast ocean. The belt of ancient rocks of 2,000 million years from Brazil coast matches with those from western Africa. The earliest marine deposits along the coastline of South America and Africa are of the Jurassic age.

This suggests that the ocean did not exist prior to that time.

76. Solution: (c)

Exp) Option c is the correct answer.

Alfred Wegner proposed the Continental Drift Theory to explain the movement of continents over the geological period of time.

Statement 1 is correct: Continental drift refers to the large-scale horizontal movements of continents relative to one another and to the ocean basins during one or more episodes of geologic time.

Statement 2 is correct: Evidences of Continental drift:

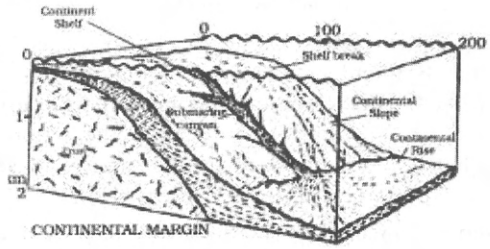
- **The Matching of Continents (Jig-Saw-Fit): The shorelines of Africa and South America facing each other have a remarkable and unmistakable match.** The match was tried at 1,000- fathom line instead of the present shoreline.
- Rocks of Same Age across the Oceans: The belt of ancient rocks of 2,000 million years from Brazil coast matches with those from western Africa. The earliest marine deposits along the coastline of South America and Africa are of the Jurassic age. This suggests that the ocean did not exist prior to that time.
- Distribution of Fossils: The observations that Lemurs occur in India, Madagascar and Africa led some to consider a contiguous landmass 'Lemuria' linking these three landmasses. The skeletons of Mesosaurus are found only in two localities: the Southern Cape province of South Africa and Iraver formations of Brazil.

Statement 3 is incorrect: Alfred Wegener suggested that the movement responsible for the drifting of the continents was caused by pole-fleeing force and tidal force. But most of scholars considered these forces to be totally inadequate. In Convectional Current Theory, Arthur Holmes in 1930s discussed the possibility of **convection currents operating in the mantle portion**. These currents are generated due to radioactive elements causing thermal differences in the mantle portion. As per the Plate Tectonic theory, these convective currents are considered as the major forces for the tectonic movement.

77. Solution: (c)

Exp) Option c is the correct answer.

continental margin is the transition zone which connects continental crust to the oceanic crust.



Option a is incorrect: The continental slope starts at the bottom of the continental shelf sharply drops off into a steep slope. It connects the continental shelf and the ocean basins. The depth of the slope region ranges from 200 to 3,000 m. The slope boundary indicates the end of the continents. Canyons and trenches are observed in this region.

Option b is incorrect: The continental shelf is the shallowest part of the ocean showing an average gradient of 1° or even less. It is the margin stretched out of each continent. It is occupied by relatively shallow seas and gulfs. The width of the continental shelves varies from one ocean to another.

Option c is correct: Continental margin is the region that form the transition between continental shores and deep-sea basins. They include continental shelf, continental slope, continental rise and deep-oceanic trenches.

Option d is incorrect: Deep Sea plain are gently sloping areas of the ocean basins. These are the flattest and smoothest regions of the world. The depths vary between 3,000 and 6,000m.

78. Solution: (b)

Exp) Option b is the correct answer.

Plate boundaries refers to the region where two tectonic plate meets. Most of the geological activities takes place at the plate boundary. A single tectonic plate can have multiple plate boundaries. There are three types of plate boundaries:

i) Convergent plate boundary: It refers to the region where the crust is destroyed as **one Earth's plate subducts below another plate.** The site where sinking of a plate occurs is called a **subduction zone.**

ii) Divergent plate boundary: It refers to the site where new crust is formed when the **Earth's plates move away from each other.** The sites where the plates pull away from each other are called spreading sites.

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ii) Transform plate boundary: It refers to the place where the crust is neither produced nor destroyed as the **plates slide horizontally past each other.**

Statement 1 is correct: Island arcs are long curved chains of volcanic islands found along the convergent tectonic plate boundaries. Island arcs result due to the interaction of two oceanic crust where they converge and form the subduction zone. For example, Japanese Island.

Statement 2 is incorrect: Volcanoes observed at the divergent plate boundary **are less violent than those appearing at the subduction zone of convergent plate boundary.** The reason being the magma at convergent site is more viscous and it has more volatile material (mostly water).

Statement 3 is correct: Rift valley is a linear shaped lowland region that is found between the mountain ranges. It is formed **when Earth's tectonic plates move apart or diverges.** Rift valleys are found both on land and at the bottom of the ocean, where they are created by the process of seafloor spreading. For example, East African rift valley.

Statement 4 is incorrect: The third type of plate boundary occurs where tectonic plates slide horizontally past each other. This is known as a transform plate boundary. As the plates rub against each other, huge stresses can cause portions of the rock to break, resulting in **earthquakes.** Places where these breaks occur are called faults. A well-known example of a transform plate boundary is the San Andreas Fault in California.

79. Solution: (b)

Exp) Option b is the correct answer.

Seafloor spreading is a geologic process where there is a gradual addition of new oceanic crust in the ocean floor through volcanic activity while moving the older rocks away from the mid-oceanic ridge. Seafloor spreading was proposed by an American geophysicist, Harry H. Hess in 1960 when he provided evidence in support of this.

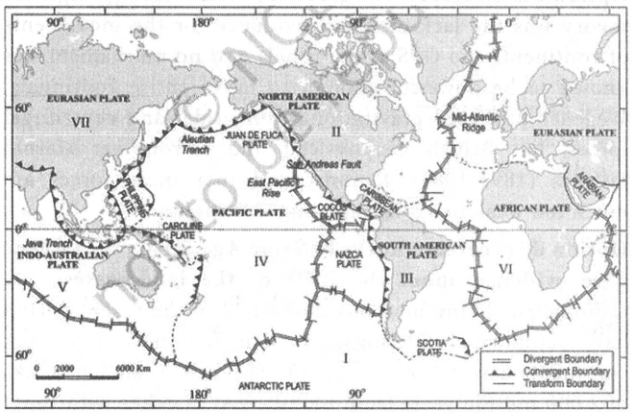
Statement 1 is correct: Particularly, the mapping of the ocean floor and palaeomagnetic studies of rocks from oceanic regions revealed the following facts: **The rocks equidistant on either side** of the crest of mid-oceanic ridges show remarkable similarities **in terms of the period of formation, chemical compositions,** and **magnetic properties.** Rocks closer to the mid-oceanic ridges have normal polarity and are the youngest. The age of the rocks increases as one moves away from the crest. This records that there is a constant movement and spreading of rocks on the ocean floor.

Statement 2 is incorrect: The ocean crust rocks are much younger than the continental rocks. The age of rocks in the oceanic crust is nowhere more than 200 million years old. Some of the continental rock formations are as old as 3,200 million years. It is clear evidence that the formation of rocks on the sea floor is due to the reabsorption of materials.

Statement 3 is correct: The condition on the mid-oceanic ridge was substantially different from other surfaces away from the region because of the warmer temperature. The **molten magma** from the mantle **arose** due to the **convection currents** in the interior of the earth. This makes the **temperature near the mid-oceanic ridge becomes warm** and the other surface to become cold because as the molten magma continues to push upward, it moves the rocks away from the ridge.

80. Solution: (a)

Exp) Option a is the correct answer.



Pair 1 is incorrectly matched: The Nazca Plate is a small oceanic tectonic plate in the eastern Pacific Ocean. It is bounded by the South American Plate to the east, the Pacific Plate to the west, and the Cocos Plate to the north (not between Central America and Pacific Plate). The Nazca Plate is moving westward at a rate of about 8 centimeters (about 3.15 in) per year, and it is slowly being subducted under the South American Plate. This subduction process is responsible for creating the Andes Mountains and for frequent earthquakes and volcanic eruptions along the western coast of South America.

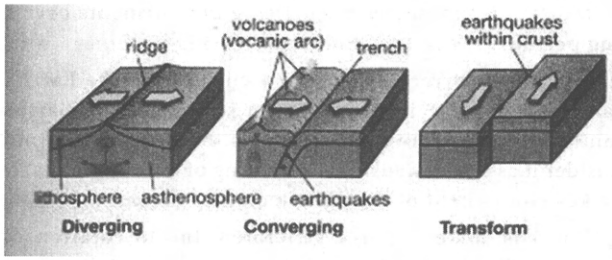
Pair 2 is incorrectly matched: Formed around 23 million years ago, the Cocos Plate is a youthful oceanic tectonic plate situated between Central America and Pacific plate **(not Between South America and Pacific plate).** Its name is derived from Cocos Island, situated above it, and its origin traces back to the fragmentation of the Farallon Plate, a process that concurrently gave rise to the Nazca Plate.

Pair 3 is correctly matched: The Caroline Plate is a small, oceanic tectonic plate in the western Pacific Ocean. It lies between the Philippine and Indian plate (North of New Guinea).

81. Solution: (d)

Exp) Option d is the correct answer.

Plate tectonics is a fundamental theory in geology that explains the movement of the Earth's lithospheric plates, which float on the semi-fluid asthenosphere beneath them. **Transform boundaries** are one of the three main types of plate boundaries, **along with divergent and convergent boundaries.** At transform boundaries, **two lithospheric plates just slide past each other** horizontally, without any subduction or divergence. **Examples include the San Andreas fault in the USA and the Anatolian fault in Asia Minor.**



Statement-I is incorrect: In transform boundaries, the plates rub against each other. This creates **huge stress and can cause the portions of the rocks to break.** This results in **earthquakes.** Places where these breaks take place are called **faults**.

Statement-II is correct: Unlike divergent boundaries, where new lithosphere is created through volcanic activity, or convergent boundaries, where lithosphere is destroyed through subduction, **transform boundaries do not involve the creation or destruction of lithosphere**. Rather, **segments of crust are ripped apart** within a wide area of shearing occurring between the two plates. Due to this, this type of plate boundary is also called **a conservative plate boundary**.

82. Solution: (a)

Exp) option a is the correct answer.

Option a is correct. The **Clarion-Clipperton Zone (CCZ)** is a **vast underwater region in the central Pacific Ocean, located between Hawaii and Mexico**. It is **one of the most mineral-rich areas in the deep sea**, containing **huge deposits of polymetallic nodules**. These nodules are rich in **manganese, nickel, copper, and cobalt**, making the CCZ a key area for potential **deep-sea mining operations.**

The **CCZ covers around 6 million square kilometers**, making it one of the **largest untapped sources of rare metals. Countries and corporations are interested in mining these resources**, but concerns over **marine biodiversity and ecosystem damage** have slowed commercial mining efforts. The **International Seabed Authority (ISA) regulates exploration and mining** in the CCZ under the **United Nations Convention on the Law of the Sea (UNCLOS).**

Option b is incorrect. The CCZ is not located in the Atlantic Ocean; it is in the Pacific Ocean. It is not a tectonic plate boundary and does not experience frequent earthquakes or volcanic activity. Tectonic plate boundaries are associated with subduction zones, mid-ocean ridges, and transform faults, which cause earthquakes and volcanic eruptions. The Mid-Atlantic Ridge is a major tectonic boundary where the **Eurasian and North American plates diverge**, causing frequent earthquakes and volcanic activity.

Option c is incorrect. Upwelling zones occur when cold, nutrient-rich water rises to the surface, increasing marine productivity and fish populations. The **CCZ is a deep-sea area (3,000–5,500 meters deep) with very low biological productivity**, meaning it does not support rich marine life like upwelling zones do. For example, the **Benguela Upwelling System** off the coast of **Namibia and South Africa** in the Atlantic Ocean and the **Peru-Humboldt Current Upwelling System** in the **Pacific Ocean** supports one of the world's largest fisheries.

Option d is incorrect. Coral reefs are found in warm, shallow waters (0–50 meters deep), while the CCZ is a deep-sea area (3,000–5,500 meters deep). The CCZ does not contain coral reefs; it consists of a vast, muddy seabed covered with polymetallic nodules. The **CCZ lacks the sunlight necessary for coral reef ecosystems to thrive**. For example, the **Great Barrier Reef (Australia)** is the **largest coral reef system in the world and** The **Coral Triangle (between Indonesia, the Philippines, and Malaysia)** is known for its exceptional coral biodiversity.

83. Solution: (c)

Exp) Option c is the correct answer.

The theory of plate tectonics proposes that the Earth's lithosphere is divided into seven major and some minor tectonic plates. These plates lie on top of a partially molten layer of rock called the asthenosphere. Due to the convection of the asthenosphere and lithosphere, the plates move relative to each other at different rates. These plates thus interact with each other through divergence and convergence.

When plates move towards each other, crashing against one another, they are called convergent plate boundaries.

When they move away from each other, tearing apart from each other, they are called divergent plate boundaries.

This interaction of tectonic plates is responsible for many different geological formations.

Option 1 is correct. A volcano is a feature in Earth's crust where molten rock is squeezed out onto Earth's surface. Most volcanoes form at the boundaries of Earth's tectonic plates. **Volcanoes are formed both at divergent plate boundaries and at convergent plate boundaries.**

At a divergent boundary, tectonic plates move apart from one another forming undersea mid oceanic ridges. These ridges are interconnected, forming a continuous volcanic mountain range. Vents and fractures (also called fissures) in these mid-ocean ridges allow magma and gases to escape into the ocean.

Option 2 is correct. A rift valley is a lowland region that forms where Earth's tectonic plates move apart, or rift. Rift valleys are formed when tectonics plates beneath the Earth's surface diverge (i.e. move away from one another in opposite directions). Rift valleys differ from river valleys and glacial valleys in that they are created by tectonic activity.

Option 3 is correct. Mid Oceanic Ridges refers to an interconnected chain of mountain systems within the ocean. **Mid-oceanic Ridges occur along divergent plate boundaries,** where a new ocean floor is created as the Earth's tectonic plates spread apart. As the plates separate, molten rock rises to the seafloor, producing enormous volcanic eruptions of basalt, creating a long chain of ridges.

The mid-ocean ridges are the most extensive chain of mountains on Earth's ocean floors.

Option 4 is incorrect. Ocean trenches are long, narrow depressions on the seafloor. **Ocean trenches are a feature of**

convergent plate boundaries, where two or more tectonic plates meet. When a dense tectonic plate meets a less-dense plate, the denser plate bends downward and subducts under the less-dense one, creating a trench. This place where the denser plate subducts is called a subduction zone. This subduction leads to formation of trenches.

84. Solution: (a)

Exp) Option a is the correct answer.

Both Statement-I and Statement-II are correct, and Statement-II explains Statement-I: Fold mountains are formed due to the collision of tectonic plates, particularly at **convergent plate boundaries**. In many cases, especially where an **oceanic plate collides with a continental plate**, subduction occurs, leading to the formation of magma. This magma can rise to the surface, causing volcanic activity near fold mountain ranges.For example: The Andes Mountains in South America are fold mountains formed due to the subduction of the Nazca Plate beneath the South American Plate, leading to both mountain formation and volcanic activity.

85. Solution: (d)

Exp) Option d is the correct answer.

The Great African Rift Valley, Hunsrück, and Vosges Mountains were all **formed due to faulting, which occurs when the Earth's crust breaks and blocks of land move up (horsts) or down (grabens).** This is typical of Block Mountains and rift valleys.

The **Great African Rift Valley, Hunsrück, and Vosges Mountains (Horst)** are all examples of landforms created due to **faulting**, which occurs when the Earth's crust **breaks and moves along fractures (fault lines)** due to tectonic forces. This leads to the formation of two primary structures:

- **Horst (Uplifted Block):** A block of the Earth's crust that has moved **upward** between two faults. The **Vosges Mountains (France) and Hunsrück (Germany)** are classic examples of **horsts**.
- **Graben (Rift or Depressed Block):** A block that has moved **downward**, forming a valley. The **Great African Rift Valley** is a massive graben system.

86. Solution: (b)

Exp) Option b is the correct answer.

The continental drift theory, first proposed by Alfred Wegener in 1912, suggests that Earth's continents were once joined together in a single supercontinent called Pangea. This supercontinent began to break apart about 200 million years ago and gradually drifted to their current positions. Wegener's continental drift theory proposed various forces to explain the drifting of continents. Let's analyze each force mentioned in the options:

Option 1 is correct: Attraction force between moon and the Earth: This force refers to the gravitational pull between the Earth and the Moon. **Wegener suggested that the tidal force due to the gravitational pull between the Earth and the Moon contributes to the drifting of continents over a long period.**

Option 2 is incorrect: Convection currents in the Earth's mantle: This force involves the movement of the Earth's mantle driven by convection currents. But Wegner did not consider it as a force causing the drifting of the continents. **It is a key component of the plate tectonics theory.**

Option 3 is correct: Force generated due to rotation of Earth: The Earth's rotation contributes to the Coriolis effect, influencing ocean currents and atmospheric circulation. **Wegener considered this force to explain continental drift theory.**

Option 4 is incorrect: Tensional forces at plate boundaries play a crucial role in the geological processes. But Wegner did not consider it as a force for the drifting of the continents.

87. Solution: (c)

Exp) Option c is the correct answer.

The Convection Current Theory, proposed by Arthur Holmes in the 1930s, explains the movement of Earth's lithospheric plates. Holmes suggested that convection currents in the mantle drive the movement of tectonic plates and contribute to the formation of geological features.

Statement 1 is correct: Arthur Holmes' theory of convection currents in the mantle provided the mechanism behind continental movement by suggesting that heat from radioactive decay within the Earth's interior causes the mantle to heat up. **As the mantle material becomes hotter, it becomes less dense and rises toward the Earth's surface. When it cools down, it becomes denser and sinks back toward the core. This circular motion, called convection currents, creates a flow of material that can exert a force on the Earth's lithosphere (the rigid outer layer of the Earth), causing the continents to move.** These convection currents act as the driving force that can push the tectonic plates on the Earth's surface, which include the continents. This mechanism addressed the key problem in Wegener's continental drift theory, which lacked an explanation for what could generate enough force to move the large landmasses

Statement 2 is correct: Holmes proposed that **convection currents are generated due to thermal differences in the mantle, caused by radioactive elements.**

88. Solution: (a)

Exp) Option a is the correct answer.

Alfred Wegener proposed the Continental Drift Theory to explain the movement of continents over the geological period of time. According to Wegener:

- In the beginning, all the continents formed a single continental mass and a mega ocean surrounded the same.
- He argued that, around 200 million years ago, the supercontinent, Pangaea, began to split. Pangaea first broke into two large continental masses as Laurasia and Gondwanaland forming the northern and southern components respectively.
- Subsequently, Laurasia and Gondwanaland continued to break into various smaller continents that exist today.

He offered a variety of evidence supporting his continental drift theory.

Statement 1 is correct. The **Matching of coastlines of Continents** supports the Continental drift theory. The **east coast of South America and the west coast of Africa seem to fit together** like pieces of a jigsaw puzzle, and Wegener discovered their rock layers "fit" just as clearly. It suggests that they were broken from a single large landmass.

Statement 2 is incorrect. The fact that earthquakes and volcanic eruptions mostly occur along the margins of continents is a strong piece of **evidence supporting the theory of plate tectonics.** The plate boundaries are where most tectonic activity happens due to the movement and interaction of different plates.

A plate boundary where tectonic plates slide horizontally past each other is known as a transform plate boundary. As the plates rub against each other, huge stresses can cause portions of the rock to break, resulting in earthquakes.

Statement 3 is correct. Sedimentary rocks formed from glacial deposits, known as tillite, have been discovered in regions like South Africa, India, Australia, and South America. The **Gondwana system of sediments from India is known to have its counterparts in six different landmasses of the Southern Hemisphere**. Counterparts of this succession are found in Africa, Falkland Island, Madagascar, Antarctica and Australia. These deposits **indicate a shared glacial history, suggesting these continents were once connected.**

Statement 4 is incorrect. The fact that Earth's magnetic field has reversed after every few hundred thousand years is considered strong **evidence supporting the seafloor spreading theory.**

Scientists have discovered that the magnetic poles of the earth have reversed many times throughout its history. Magnetic reversals are also recorded in the rock making up the oceanic crust, and the pattern they create is evidence of seafloor spreading.

Statement 5 is incorrect. The presence of mid-oceanic ridges on the seafloor **provides evidence of plate tectonic theory.** Mid-ocean ridges occur along divergent plate boundaries, where a new ocean floor is created as the Earth's tectonic plates spread apart. As the plates separate, molten rock rises to the seafloor, producing enormous volcanic eruptions of basalt, creating a long chain of ridges.

The mid-ocean ridges are the most extensive chain of mountains on Earth's ocean floors.

89. Solution: (d)

Exp) Option d is the correct answer.

India was a large island situated off the Australian coast, in a vast ocean. The Tethys Sea separated it from the Asian continent till about 225 million years ago. India is supposed to have started her northward journey about 200 million years ago at the time when Pangaea broke.

Statement 1 is correct. India collided with Asia about 40-50 million years ago causing rapid uplift of the Himalayas. The subcontinent was still close to the equator. From 40 million years ago and thereafter, the event of formation of the Himalayas took place**. Scientists believe that the process is still continuing and the height of the Himalayas is rising even to this date.**

Statement 2 is correct. The past earthquakes and possible future earthquakes along the plate interior depend either upon the internal lithospheric stress or on the stress from the plate boundary**. The northward movement of the Indian tectonic plate pushing slowly against the Asiatic plate is evident by the frequent earthquakes in the region.**

Statement 3 is correct. The two major plates were separated by the Tethys Sea and the Tibetan block was closer to the Asiatic landmass. During the movement of the Indian plate towards the Eurasian plate, **a major event that occurred was the outpouring of lava and formation of the Deccan Traps.**

90. Solution: (b)

Exp) Option b is the correct answer.

Pair 1 is incorrectly matched. Continental drift is the hypothesis that the Earth's continents have moved over geologic time relative to each other, thus appearing to have "drifted" across the ocean bed. The speculation that continents might have 'drifted' was first put forward by **Abraham Ortelius in 1596.** A pioneer of the modern view of mobilise was the Austrian geologist, Otto Ampferer. The **concept was independently and more fully developed by Alfred Wegener** in 1912, but his hypothesis was rejected by many for lack of any motive mechanism. **Arthur Holmes later proposed mantle convection for that mechanism.** The idea of continental drift has since been subsumed into the science of plate tectonics, which studies the movement of the continents as they ride on plates of the Earth's lithosphere.

Edwin Hubble contribution was in describing the universe's rate of expansion.

Pair 2 is incorrectly matched. The **expansion of the universe** is the increase in distance between any two given gravitationally unbound parts of the observable universe with time. **Edwin Hubble contributed in development of expansion of universe theory.** Hubble's brilliant observation was that the red **shift of galaxies was directly proportional to the distance of the galaxy from earth**. That meant that things farther away from Earth were moving away faster. In other words, the universe must be expanding. He **announced his finding in 1929**.

Pair 3 is correctly matched. Photoelectric effect is phenomenon in which electrically charged particles are released from or within a material when it absorbs electromagnetic radiation. The effect is often defined as the ejection of electrons from a metal plate when light falls on it. In a broader definition, the radiant energy may be infrared, visible, or ultraviolet light, X-rays, or gamma rays; the material may be a solid, liquid, or gas. The released particles may be ions (electrically charged atoms or molecules) as well as electrons. The phenomenon was fundamentally significant in the development of modern physics because of the puzzling questions it raised about the nature of light—particle versus wavelike behaviour—that **were finally resolved by Albert Einstein in 1905.**

91. Solution: (b)

Exp) Option b is the correct answer.

According to plate tectonic theory fold mountains are formed due to collision of two convergent plates. Fold mountains are formed along the destructive plate boundaries. It is obvious that the process of mountain building is associated with destructive plate boundaries of two convergent plates. **The plate tectonic theory envisages the formation of mountains due to compression of sediments caused by the collision of two convergent plate boundaries.**

Statement 1 is incorrect. The Himalayan Mountain range was formed as the Indian tectonic plate collided into the Eurasian plate about 50 million years ago. The process continues even today, which causes the height of the mountain range to rise every year. However, this process can be disrupted by other natural events like earthquakes.

The peak of Mt Everest rises in height by approximately 2 cm each year. If the plate tectonic activity stops, **the height of Mt Everest, may not increase or decrease.**

The height of Mt Everest, was revised in 2020 jointly by Nepal and China. It now measures 8,848.86 metres, up by 0.86 metres. It is thought that the earthquake of April 2015 in Nepal might have lowered the height of the peak.

Statement 2 is correct. According to the Plate Tectonic Theory, the oceanic crust has its origin at the mid oceanic ridges. The oceanic crust originates from the Mid-oceanic Ridges and spreads towards the continents and then it goes down to magma again and it melts.

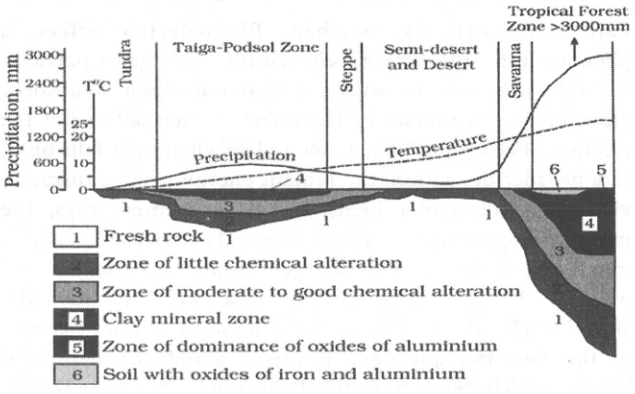
As with oceanic crust, continental crust is created by plate tectonics. At convergent plate boundaries, where tectonic plates crash into each other, continental crust is thrust up in the process of orogeny, or mountain-building. Thus, in the absence of plate tectonics movement there will be no new formation of oceanic and continental crust.

2.5. Geomorphic Processes and Landforms

92. Solution: (c)

Exp) Option c is the correct answer.

The **weathering mantle** is the layer of decomposed rock and soil that forms above the bedrock due to weathering processes. Its depth varies significantly across different biomes, and depends on climatic conditions, which influence the rate and intensity of weathering processes.



Climatic regimes and depth of weathering mantles

Option c is correct: Tropical forests are characterized by their warm temperatures, high levels of precipitation, and lush, dense vegetation. All these factors promote intense chemical weathering in the tropical forests. As a result, tropical forests have a **deep weathering mantle**, often extending several meters or even tens of meters below the surface.

Tundra and desert biomes typically have much less weathering. The tundra has cold temperatures and minimal precipitation, which slows down weathering. Deserts, while hot, receive very little rainfall, limiting the extent of weathering.

Taiga (boreal forests) experiences cooler climates, which also slows the weathering processes compared to tropical forests.

93. Solution: (b)

Exp) Option b is the correct answer.

Erosional desert landforms are created by the action of wind and water on the landscape.

Options 1 and 2 are incorrect: Barchans and Loess are examples of depositional landforms of the desert. Barchans are primarily crescent-shaped sand dunes that are likely to shift while facing the wind with intensity from one particular direction. Loess is defined as sediment that has been entrained, transported, and deposited by the wind and is dominated by silt-sized (50–2 μm diameter) particles.

Option 3 is correct: Hoodoos are tall, thin spires of rock that are formed by the erosive action of wind and water on soft rock formations. They are also an example of an erosional desert landform.

Option 4 is correct: Mesas are flat-topped hills with steep sides that are formed by the erosion of softer rock layers that cover harder, underlying rock formations. They are also an example of an erosional desert landform.

Option 5 is correct: Inselbergs are isolated hills or mountains that rise abruptly from a plain or desert floor. They are formed by the exposure of hard, resistant rock that has been uplifted and eroded over time.

94. Solution: (a)

Exp) Option a is the correct answer.

Karst Topography is the formation of landforms due to solution and deposition on any limestone or dolomitic region by the action of groundwater or surface water. It is a type of landscape where the dissolving of the bedrock has created sinkholes, sinking streams, caves, springs, and other characteristic features.

The most characteristic stretch of limestone occurs in north-west Yugoslavia. Other regions include: the Causses district of southern France, the Pennines of Britain, Yorkshire and Derbyshire in particular, **the Kentucky region of the United States, the Yucatan Peninsula of Mexico, the Cockpit Country of Jamacia, and the limestone hills of Perlis.**

95. Solution: (c)

Exp) option c is the correct answer.

Option a is incorrect. Monadnock is an isolated hill of bedrock standing conspicuously above the general level of the surrounding area. Monadnocks are left as erosional remnants because of their more resistant rock composition.

Option b is incorrect. Peneplains represent low **featureless plain** having undulating surface and remnants of convexo-con- cave residual hills. These are, in fact, the end products of the normal cycle of erosion. It refers to an undulating featureless plain punctuated with low-lying residual hills of resistant rocks. It is considered to be an end product of an erosional cycle.

Option c is correct. Natural levees are embankments formed naturally after a river floods and recede. Friction with the floodplain during a flood causes a decrease in the velocity of the river leading to the deposit of the material that the flood water is carrying. The deposits in natural levees contain **mud, sand, and stones** and are formed such that they slope away from either side of the river or flood plain. Levees also **direct the flow of the river.**

Option d is incorrect. . Rapids are areas of shallow, fast-flowing water in a stream. Rapids tend to form in younger streams, with water flow that is straighter and faster than in older streams. Softer rocks in the streambed erode, or wear away, faster than harder rocks.

96. Solution: (a)

Exp) option a is the correct answer

A depositional landform is **a landform that is created from glacial deposits**. This is when a glacier carries some sediment, which is then placed (deposited) somewhere else. This could be a large group of glacial sediment or a single significant material.

Option 1 is correct: Esker refers to **Winding ridge of un-assorted depositions of rock, gravel, clay etc.** running along a glacier in a till plain. The eskers resemble the features of an embankment and are often used for making roads. It is a type of depositional feature of glacial.

Option 2 is correct: Drumlin have been formed by the streamlined movement of glacial ice sheets across rock debris, or till. It looks like an Inverted boat-shaped deposition in a till plain. These are mainly depositional features of glaciers.

Option 3 is incorrect: When the divide between two cirque walls gets narrow because of progressive erosions, it results in the formation of a saw-toothed ridge called **Arete**. They are formed by **headward erosion** of cirque wall.

Option 4 is incorrect: Cirque is Hollow basin cut into a mountain ridge. It has steep sided slope on three sides, an open end on one side and a flat bottom. When the ice melts, the cirque may develop into a tarn lake. It is an **erosional landform.**

97. Solution: (c)

Exp) option c is the correct answer

Statement 1 is correct: Moraines are glacial landforms formed by the deposition of glacial sediments that accumulate along the edges and at the terminus of a glacier. Moraines are typically composed of **unsorted glacial debris including rocks, boulders, gravel, sand, and clay.** These landforms are important indicators of past glacial activity and can be used to reconstruct the history of a glacier, including its size, shape, direction of movement, and the timing of its advance and retreat.

Statement 2 is correct: By studying the characteristics of moraines, scientists **can reconstruct the history of a glacier, including its size, shape, direction of movement,** and the timing of its advance and retreat. **For example,** the location of a terminal moraine can provide an estimate of the maximum extent of the glacier during its last advance, while the size and shape of lateral moraines can provide information about the width and direction of the glacier's movement.

98. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect: Alluvial fans are depositional landforms not erosional landforms. An alluvial fan is a triangle-shaped *deposit* of gravel, sand, and even smaller pieces of sediment, such as silt. This sediment is called alluvium. **A river mouth is a place where a river flows into another larger body of water like ocean or large lakes.** Generally, deltas are formed at the river mouth.

Statement 2 is *incorrect*: Alluvial fans are even found underwater. An underwater fan is created as an underwater current deposits alluvium from a submarine hill or glacier.

Statement 3 is correct: Sometimes, fans are formed without the aid of water. These are called colluvial fans. **Colluvial fans are created by mass wasting.** Mass wasting is simply the downward movement of rock, soil, or other material. **Alluvium is a material transported by water, while colluvium is material transported by mass wasting.** Landslides are an instance of mass wasting that often create colluvial fans.

99. Solution: (b)

Exp) Option b is the correct answer.

The middle course of a river has more energy and volume than the upper course. The gradient is gentler and more lateral (sideways) erosion has widened the channel. The river channel has also become deeper. Meanders are typical landforms found in this stage of the river.

Statement 1 is incorrect: A meander is a winding curve or bend in a river. They are typical of the middle and lower course of a river. **This is because vertical erosion is replaced by a sideways form of erosion called LATERAL erosion, plus deposition within the floodplain.**

Statement 2 is correct: A meander is formed because the river flows faster on the outside edge of any small curve and slower along the inside edge. Deposition of sediment occurs on the inner edge because the river, moving slowly, cannot carry its sediment load, creating a slip-off slope. The faster

moving current on the outside bend has more erosive ability and the meander tends to grow in the direction of the outside bend, forming a river cliff.

100. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Cavern is an underground cave formed by water action by various methods in a limestone or chalk area. Cave formation is prominent in areas where there are alternating beds of rocks (shales, sandstones, quartzites) with limestones or dolomites in between or in areas where limestones are dense, massive and occurring as thick beds.

Statement 2 is correct: Borra Caves located in the Visakhapatnam district of Andhra Pradesh is a prominent example of caverns in India. Among the deepest caves of India, the Borra cave was created millions of years ago by the karstic action of the Gosthani river and has some spectacular speleothems. The local tribals also associate several legends with the cave. The cave is also highly valuable for anthropological research, with excavations unearthing stone tools of middle Paleolithic culture (confirming human habitation in the area dating back to between 30,000 and 50,000 years ago)

Important Tips

Geologists refer to the mineral formations in caves as "speleothems." While the water flows, the speleothems grow in thin, shiny layers. The amount of growth is an indicator of how much ground water dripped into the cave. Little growth might indicate a drought, just as rapid growth could point to heavy precipitation. When the speleothems stop growing, the outside becomes dirty and eroded in places, giving it a dull appearance. A growing speleothem looks smooth and wet.

101. Solution: (a)

Exp) Option a is the correct answer.

Coastline is the area where land meets water. The water, with an endless supply of waves, whether pounding or gentle ripples, is constantly changing coastlines around the globe.

Option a is correct: Submergent coastlines are coastlines submerged under water due to rising sea levels. Many of these types of coastlines were actually formed toward the end of the Last Glacial Period (LGP). **Such coasts are Ria coasts, Fiord coasts, Dalmatian Coast and Estuarine coasts.**

Option b is incorrect: Emergent coastlines happen when either the water level has fallen, or the land has risen. Either way, there is now a (bit of) coastline that is no longer submerged under water. Emergent coastlines can pop up after tectonic activity. Emergent coastlines can have features such as marine terraces, relict sea cliffs, sea stacks, and raised beaches.
Option c is incorrect: Discordant coastlines occur when bands of different types of rocks run perpendicular (at 90 degrees) to the coast. These bands of rocks alternate between soft rock and hard rock, all eroding at different rates and in varying ways. Because of this difference in erosion resistance, discordant coastlines are home to **headlands**, due to eroding hard rock, and **bays**, due to eroding soft rock.

Option d is incorrect: Concordant coastlines have bands of similar rock types running parallel (alongside) to the coast. The difference in rock types between discordant and concordant coastlines means that there are differences in erosion. As mentioned earlier, discordant coastlines form headlands and bays; on the other hand, concordant coastlines form **coves**. These coves are formed by waves breaking through an outer layer of hard rock, such as limestone, and then, over time, the waves sweep away the soft rock further inland, like sand and clay, creating a cove.

102. Solution: (c)

Exp) Option c is the correct answer.

The above terms are related to the processes of erosion and weathering that occur in natural environments.

Pair 1 is correctly matched: Corrasion or abrasion is the mechanical grinding of the river's traction load against banks and bed of the river. The rock fragments are hurled against the sides of the river and also roll along the bottom of the river.

Pair 2 is correctly matched: Corrosion is the gradual destruction or alteration of a material by chemical reaction with its environment. In geology, it often refers to the dissolution of minerals in rocks by acidic water or other fluids.

Pair 3 is correctly matched: Attrition is the process by which transported materials undergo wear and tear when they collide and roll into each other. This causes coarser boulders to break down into smaller stones and angular edges to become rounded. Finer materials are carried downstream and eventually deposited.

103. Solution: (d)

Exp) Option d is the correct answer.

Option 1 is correct: Karst Topography is the formation of landforms due to solution and deposition on **any limestone or dolomitic region** by the action of groundwater or surface water. **The presence of dense limestone near the surface is an important requirement for the formation of the Karst topography.** Different types of landforms will be developed from these limestone regions/blocks due to the action of ground water and rainwater.

Option 2 is correct: A **moderate to heavy rainfall is a favorable condition for the formation of Karst topography.** Rainwater percolates along both horizontal and vertical cracks, dissolving the limestone and carrying it away in solution.

Option 3 is correct: Good groundwater circulation is an important condition for the formation of karst topography. Ground water act as a primary agent in the formation of the karst landforms.

104. Solution: (c)

Exp) Option c is the correct answer.

Rivers go through three main stages - the youthful or upper course, the mature or middle course, and the old or lower course.

V-shaped valleys, rapids, and plunge pools are typically formed by the river in its upper course or young age, while meanders and oxbow lakes are formed in the middle and lower course of the river.

Option 1 is incorrect: Interlocking spurs are convex (rounded) slopes that extend alternately from opposite sides of a valley, each one fitting into the "gap" between two similar slopes on the other side. Interlocking spurs are the predominant feature of mature stage.

Option 2 is incorrect: Oxbow lakes are formed during the old or lower stages of a river's development, when it has a low gradient and a meandering course. They are formed when a meandering river erodes the outer banks of a bend, causing the river to take a new, straighter course and leaving the old bend cut off from the main channel.

Option 3 is correct: V-shaped valleys are typically formed during the youthful stage of a river's development, when it has a high gradient and a greater erosive power. The river erodes the sides and bottom of the valley, creating a narrow, V-shaped channel.

Option 4 is correct: Rapids are formed wherever there is a sudden change in the river's gradient or where there are obstructions such as rocks or boulders in the river's course. They can form at any stage of a river's development but are most common during the youthful stage.

Option 5 is correct: Plunge pools are typically formed during the youthful stages of a river's development, when it has a greater erosive power. They are formed by the erosive action of falling water at the base of a waterfall or rapids.

Important Tips

a) Youthful or Upper Course

a. V-shaped valleys
b. Waterfalls
c. Rapids
d. Plunge pools
e. Gorges

b) Mature or Middle Course

a. Meanders
b. Interlocking spurs
c. River cliff and slip off slopes

c) Old or Lower Course

a. Deltas
b. Oxbow lakes
c. Floodplains
d. Braided Channels
e. Estuaries
f. Natural levees
g. Bayous

105. Solution: (c)

Exp) Option c is the correct answer.

Ox-Bow lakes are U-shaped bodies of water that form when a river's meander becomes so pronounced that it erodes the narrow strip of land between two bends and creates a new channel. As a result, a part of the river is cut off from the main channel, and the water gets collected in a curved lake.

Option 1 is incorrect: Chilika Lake is not an example of an Ox-Bow Lake as it is a lagoon, which is a shallow coastal water body separated from the sea by a narrow strip of land.

Option 2 is incorrect: Pulicat Lake is a brackish water lagoon that is located at the border of Andhra Pradesh and Tamil Nadu. The lagoon is separated from the Bay of Bengal by a sand bar and is connected to the sea by a narrow mouth.

Option 3 is correct: Kanwar jheel, as it is locally called, is located 22 km north-west of Begusarai town. It is a residual oxbow lake, formed due to meandering of Gandak river, a tributary of Ganga, in the geological past.

Option 4 is correct: Deepor Beel is a large oxbow lake located in the southwestern part of Guwahati city in Assam, India. It is a wetland of international importance under the Ramsar Convention and is also an Important Bird Area (IBA).

106. Solution: (c)

Exp) Option c is the correct answer.

The Delta is originated from the Greek letter Δ which closely resembled the triangular delta of the Nile. It is formed when a river reaches the sea, and the fine materials it has not yet dropped are deposited at its mouth, forming a fan-shaped alluvial area. A number of factors such as the rate of sedimentation, the depth of the river and the seabed, and the character of the tides, currents and waves greatly influence the eventual formation of delta.

Statement 1 is correct: Active vertical and lateral erosion in the upper course of the river is necessary to provide extensive sediments to be eventually deposited as deltas. It acts as a source of sedimentation for further deposition.

Statement 2 is correct: The coast should be sheltered preferably tideless. If the coast is not sheltered, then the tides may erode the deposition at the river mouth and the sediments may get washed away.

Statement 3 is correct: The sea adjoining the delta should be shallow or else the load will disappear in the deep waters. Hence, presence of longer continental shelf is one of the key requirements of the formation of delta.

Statement 4 is incorrect: There should be no large lakes in the course of the river to filter off the sediments. If there is an extensive deposition at middle of the river, due to presence of large lakes there will be not enough load to be deposited at the river mouth and hence probability of forming a delta will be less.

Statement 5 is correct: There should be no strong current running at right angles to the river mouth. If such currents are present, then they may wash away the sediment deposits and hinder the formation of delta at the river mouth.

107. Solution: (c)

Exp) Option c is the correct answer.

The downslope movement of a glacier from its snow-covered valley-head, and the intensive shattering of the upland slopes, tend to produce a depression where the firn or neve accumulates. The process of plucking operates on the back-wall, steepening it and the movement of the ice abrades the floor, deepening the depression into a steep, horse-shoe-shaped basin called a cirque (in French). It is also known as corrie.

Option a is incorrect: A tributary valley whose ice has melted and hence, hangs above the main valley so that its stream plunges down as a waterfall is known as hanging valley.

Option b is incorrect: When two corries or cirques cut back on opposite sides of a mountain, knife-edged ridges are formed called aretes (a French word).

Option d is incorrect: At the head of a glacier, where it begins to leave the snowfield of a corrie, a deep vertical crack opens up called a bergschrund (in German) or rimaye (in French).

108. Solution: (b)

Exp) Option b is the correct answer.

Plateaux are elevated uplands with extensive level surfaces, and usually descend steeply to the surrounding lowland. They are sometimes referred to as tablelands.

Statement 1 is incorrect: Intermontane plateaus are a type of tectonic plateaus formed by earth movements which cause uplift, and are normally of a considerable size, and fairly uniform altitude. **When the plateaus are enclosed by the fold mountains, they are known as intermont plateaus. However, plateaus formed from denudation are known as dissected plateaus.** E.g., Scottish Highlands.

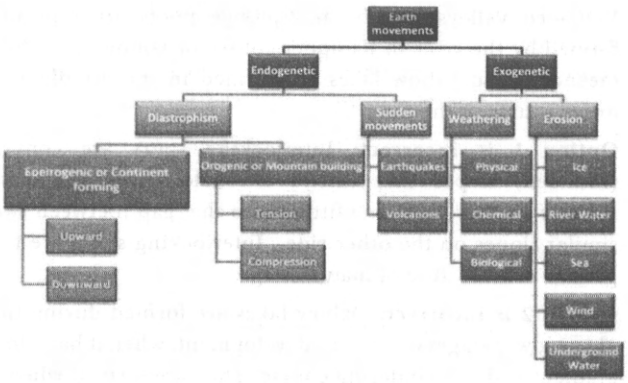
Statement 2 is correct: Intermontane plateaus are landforms bordered by mountain rims and contained by high mountain chains. They feature almost horizontal rock strata that are uplifted to great heights by vertical earth movements. Hence, **they are considered as some of the highest and the most extensive plateaus in the world.**

Statement 3 is incorrect: The Deccan plateau is an example of volcanic plateau. However, the Tibetan plateau located between the Himalayas in the south and the Kunlun Mountains in north is an example of intermont plateau. The Bolivian plateau located between the ranges of the Andes is another example.

109. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. The Eperiogenic movements are the ones which operate vertically from the center of the earth to its surface (do not work horizontally on the surface of earth) caused by radial forces (Convection Currents). It causes regional upliftment but on a large scale therefore, not much noticeable deformation of the surface takes place. Hence this statement is incorrect.



Statement 2 is correct. The Epeirogenic movements are basically the continent forming movements of earth. This movement causes regional upliftment or subsidence of the ground at a large scale without any noticeable deformation.

110. Solution: (d)

Exp) option d is the correct answer.

Weathering is defined as mechanical disintegration and chemical decomposition of rocks through the actions of various elements of weather and climate. Erosion involves acquisition and transportation of rock debris.

Statement 1 is incorrect: Weathering processes are responsible for breaking down the rocks into smaller fragments and preparing the way for formation of not only regolith and soils, but also erosion and mass movements. **Erosion cannot be significant if the rocks are not weathered and not the other way round.** Weathering is a precondition for erosion even though not necessary for it. That means, weathering aids mass wasting, erosion and reduction of relief and changes in landforms are a consequence of erosion.

Statement 2 is incorrect: As very little or no motion of materials takes place in weathering, it is an in-situ or on-site process. Weathering is a static process whereas Erosion is a mobile process. Erosion is a process often confused with weathering. Both are geological processes in which the rocks are broken down into finer particles. Erosion involves the movement of fragments of rock by the erosion processes and therefore differs from weathering, which is just concerned with the decay of rock in situ.

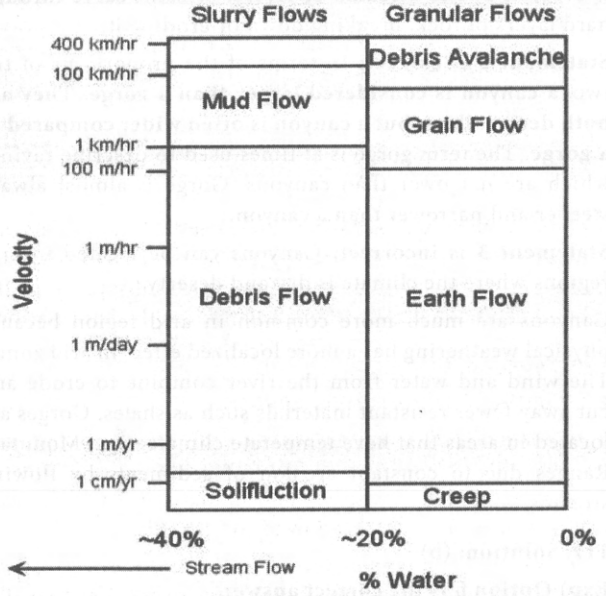
111. Solution: (d)

Exp) Option d is the correct answer.

Mass Movements involves transfer the mass of rock debris down the slopes under the direct influence of gravity. Mass movements are aided by gravity and geomorphic agent like running water, glaciers, wind, waves and currents participate in the process of mass movements.

Pair 1 is correctly matched: Solifluction - It involves slow **downslope flowing soil mass or fine-grained rock debris saturated** or lubricated with water. This process is **quite common in moist temperate areas** where surface melting of deeply frozen ground and long continued rain respectively, occur frequently. When the upper portions get saturated and when the lower parts are impervious to water percolation, flowing occurs in the upper parts.

Pair 2 is correctly matched: Debris Flows occur at higher velocities than solifluction, and often result from **heavy rains causing saturation of the soil and regolith with water.** They sometimes start with slumps and then flow downhill forming lobes with an irregular surface consisting of ridges and furrows.



Pair 3 is correctly matched: Debris Avalanches are very high velocity flows of **large volume mixtures of rock and regolith that result from complete collapse of a mountainous slope. They move down slope and then can travel for considerable distances along relatively gentle slopes.** They are often triggered by earthquakes and volcanic eruptions. Snow avalanches are similar, but usually involve only snow. **Sliding of individual rock masses down bedding, joint or fault surfaces is rockslide.**

112. Solution: (c)

Exp) Option c is the correct answer.

Land subsidence is a **gradual settling or sudden sinking** of the Earth's surface owing to subsurface movement of earth materials. Land subsidence generally occurs when **groundwater is mined in an unplanned way and large amounts of groundwater have been withdrawn from the aquifers below ground.** The impact is more evident in rocks made of fine-grained sediments. **Decline of groundwater table** causes a vertical compression of sediments bearing the water. Sometimes, lateral compression may also take place along with this vertical compression. Lowering of the pore water pressure in a layer result in an increase of the effective stress in the soil, resulting in consolidation of the soil which manifests as land subsidence.

Option a is incorrect: The **movement of a mass of rock,** debris, or earth down a slope resulting into heavy pressure on the land results into **Landslide.** Mass movement processes are occurring continuously on all slopes; some act very slowly, others occur very suddenly and is not usually the cause of land subsidence.

Option b is incorrect: Cloudbursts usually occur in connection with a thunderstorm. During these thunderstorms, a **large amount of water may accumulate at high levels** and, if the upward currents are weakened, the accumulated water comes down at one time, causing flash floods. Mountainous areas witness cloudbursts on a regular basis. Cloudbursts cause **great devastation in hilly areas** because the water gets concentrated in gullies and valleys. The flash floods due to mountain cloudbursts are "sudden" and "destructive." It is not the cause of land subsidence.

Option d is incorrect: A volcano is a vent through which molten rock and gas escape from a magma chamber. The collapse of volcanoes results into depression such as Crater Lake. They are usually **large, steep-walled, basin-shaped depressions formed by the collapse of a large area over,** and around, a volcanic vent or vents. It is not categorized as a land subsidence.

113. Solution: (b)

Exp) Option b is the correct answer.

Option a is incorrect: Structural plains are mainly formed by the uplift of a part of the seafloor or continental shelf. These are located on the borders of almost all the major continents.

Option b is correct: An outwash plain is formed by glaciers. Such a plain is **formed when a glacier deposits sediments at its terminus.** As a glacier moves, it erodes the bedrock and carries the eroded sediments downstream. These sediments are deposited by the meltwater of the glacier at the snout.

Option c is incorrect: An Outwash plain is not related to desert regions.

Option d is incorrect: A Lacustrine plain is a type of depositional plain that is formed at the bed of a lake.

114. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Mesas is an isolated, high plateau with a flat top and steep slides.

A mesa is a flat-topped mountain or hill. It is a wide, flat, elevated landform with steep sides. A mesa is a section of a plateau that has been eroded by water removing the rock so that it now has cliffs on all sides.

Statement 2 is correct: Mesas are usually found in dry regions where rock layers are horizontal. The top of the mesa is called the caprock, this upper layer is often harder and more resistant to weathering or erosion. Mesas are abundant in the southwestern states of Colorado, New Mexico, Utah, and Arizona.

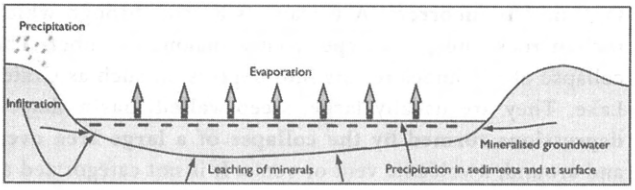
115. Solution: (b)

Exp) Option b is the correct answer.

A playa is a dry, vegetation-free, flat area at the lowest part of an undrained desert basin. It is a location where ephemeral lakes form during wet periods, and is underlain by stratified clay, silt, and sand, and commonly, soluble salts.

Statement 1 is correct: Playas are **flat-bottom depression found in interior desert basins** and adjacent to coasts within arid and semiarid regions. Playas are among the flattest known landforms.

Playas are **periodically covered by water that slowly filtrates into the ground water system or evaporates into the atmosphere,** causing the deposition of salt, sand, and mud along the bottom and around the edges of the depression. When filled with only a few centimeters of water, many kilometers of surface may be inundated.



Playas

Statement 2 is correct: Playas serve as **important sources of dust and salts. Playas may be sources of mineral deposits** formed by evaporation. Water evaporating in closed basins precipitates minerals such as gypsum.

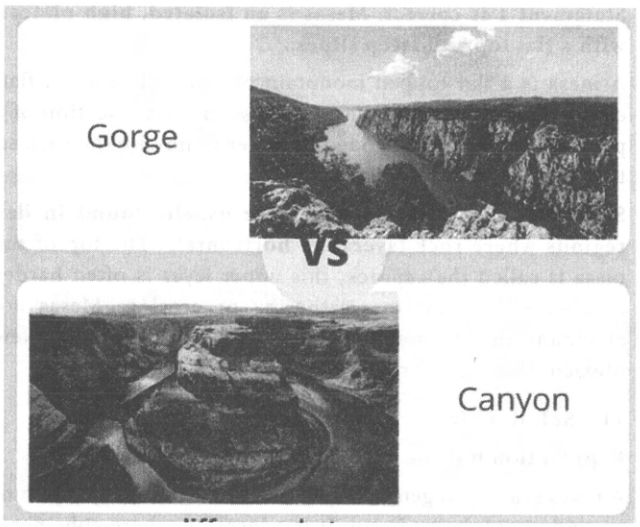
The salt deposits are found in the playas. Complex assemblages of minerals and sediments occur on the playa surfaces. These directly reflect their environment of deposition and may be used to interpret ancient environmental conditions.

Statement 3 is incorrect: Playas are the erosional landforms created by winds in the deserts (not by the water or sudden rainfall in desert).

116. Solution: (b)

Exp) Option b is the correct answer.

Canyons and gorges are geographical landforms belonging to the broad categories of valleys. Morphologically, they are **either V-shaped or U-shaped** with a down ward fold extending below the earth surface. They are classically low areas and could be separating mountains or hills.



Statement 1 is correct: The movement of rivers, **the processes of weathering and erosion,** and tectonic activity create canyons. The most familiar type of canyon is probably the river canyon. The water pressure of a river can cut deep into a river bed. Sediments from the river bed are carried downstream, creating a deep, narrow channel.

A number of natural forces form gorges. The most common is **erosion due to streams or rivers.** Streams carve through hard layers of rock, breaking down or eroding it.

Statement 2 is correct: In terms of the proportions of the two, **a canyon is considered larger than a gorge. They are both deep valleys, but a canyon is often wider compared to a gorge**. The term gorge is at times used to describe ravines which are narrower than canyons. Gorge is almost always steeper and narrower than a canyon.

Statement 3 is incorrect: Canyons can be located in arid regions where the climate is dry and deserty.

Canyons are much more common in arid region because physical weathering has a more localized effect in arid zones. The wind and water from the river combine to erode and cut away fewer resistant materials such as shales. Gorges are located in areas that have temperate climate. E.g., Mountain Ranges due to constant erosion of sediments by flowing streams.

117. Solution: (b)

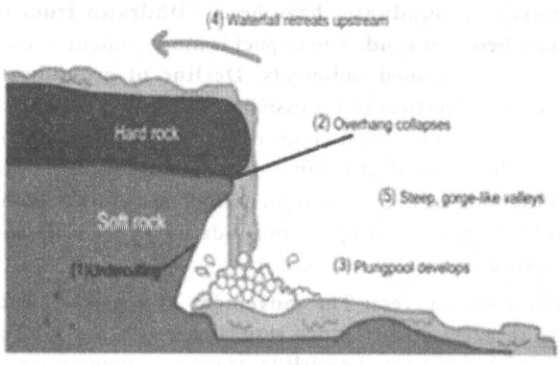
Exp) Option b is the correct answer.

A river is the best example of the **linear flow of running water**. Erosion occurs when overland flow moves soil particles downslope. The rock materials carried by erosion is the load of the river. This load acts as a grinding tool helping in cutting the bottom and sides of the river bed, resulting in deepening and widening of the river channel.

The Erosional Landforms due to Running Water are Valleys, Potholes and Plunge Pools, Incised or Entrenched Meanders and River Terraces.

Statement 1, 3 and 4 are correct:

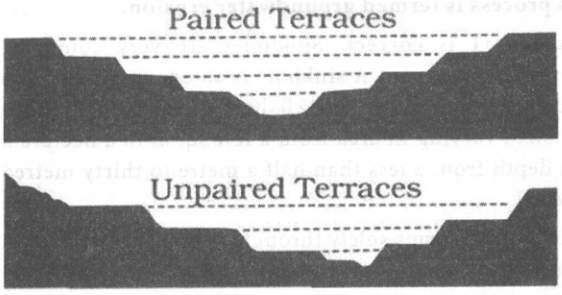
Potholes and Plunge Pools: Plunge pools are nothing but **large, deep potholes commonly found at the foot of a waterfall.** They are formed because of the sheer impact of water and rotation of boulders. Potholes are more or less circular depressions over the rocky beds of hills streams.



Plunge Pools

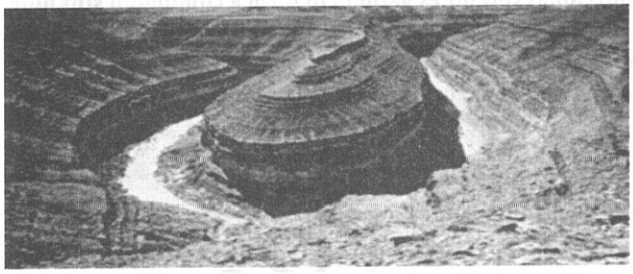
River Terraces: They are **surfaces marking** old valley floor or flood plains. They are basically the result of vertical

erosion by the stream. When the terraces are of the same elevation on either side of the river, they are called as paired terraces. When the terraces are seen only on one side with none on the other or one at quite a different elevation on the other side, they are called as unpaired terraces.



River Terraces

Incised or Entrenched Meanders: They are very **deep wide meanders** (loop-like channels) found cut in hard rocks. In the course of time, they deepen and widen to form gorges or canyons in hard rock. The difference between a normal meander and an incised/entrenched meander is that the latter found on hard rocks.



An entrenched meander loop of river Colorado in USA showing step-like side slopes of its valley typical of a canyon

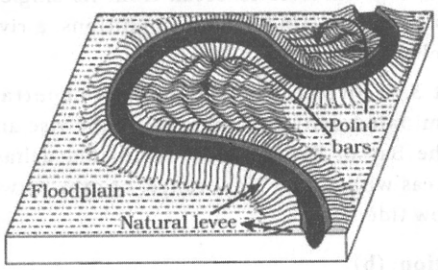
Statement 2 and 5 are incorrect: Alluvial Fans and Natural Levees are the **depositional features (not the erosional landform)** of running water. Alluvial fans are formed when streams flowing from higher levels break into foot slope plains of low gradient. Natural levees are found along the banks of large rivers. They are low, linear and parallel ridges of coarse deposits along the banks of a river

118. Solution: (b)

Exp) Option b is the correct answer.

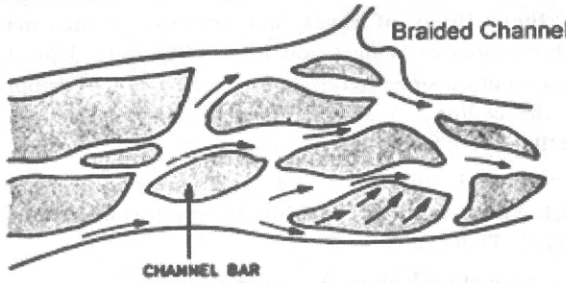
River processes, or fluvial processes, occur by erosion, transport and deposition. Deposition in a river happens when the current is no longer strong enough to carry materials, also known as sediments. The depositional landforms of Running water are **Alluvial Fans, Deltas, Floodplains, Natural Levees and Point Bars, Meanders and Braided Channels.**

Pair 1 is incorrectly matched: Point bars are found on the concave side of meanders of large rivers and are **sediments deposited in a linear fashion** by flowing waters along the bank. They are almost uniform in profile and in width and contain mixed sizes of sediments. **Natural levees are low, linear and parallel ridges of coarse** deposits along the banks of rivers, quite often cut into individual mounds. Meanders are loop-like channel patterns develop over the flood and delta plains.



Natural levee and point bars

Pair 2 is correctly matched: A braided river, or braided channel, consists of a **network of river channels separated by small, often temporary, islands** called braid bars. Braided streams tend to occur in rivers with high sediment loads or coarse grain sizes, and in rivers with steeper slopes than typical rivers with straight or meandering channel patterns. They are also associated with rivers with rapid and frequent variation in the amount of water they carry, i.e., with "flashy" rivers, and with rivers with weak banks.



Pair 3 is correctly matched: Oxbow lakes is a **U-shaped Lake or pool** that forms when a wide meander of a river is cut off, creating a free-standing body of water. An oxbow lake forms when a meandering river erodes through the neck of one of its meanders. This takes place because meanders tend to grow and become more curved over time.

119. Solution: (c)

Exp) Option c is the correct answer.

Deltas are **wetlands that form as rivers empty their water and sediment into another body of water**, such as an ocean, lake, or another river. A river moves more slowly as it nears its mouth, or end. This causes sediment, solid material carried downstream by currents, to fall to the river bottom. The slowing velocity of the river and the build-up of sediment allows the river to break from its single channel as it nears its mouth. Under the right conditions, a river forms a delta

Statement 1 is correct: Delta is a "**depositional feature** of a river formed at the mouth of the river. These are **wetlands that form as rivers empty their water** and sediment into another body of water, such as an ocean, lake, or another river. It is a **characteristic feature of a river in its senile stage (old stage).**

Statement 2 is incorrect: A river moves more slowly as it nears its mouth, or end. This causes sediment, solid material carried downstream by currents, to fall to the river bottom.

The **slowing velocity of the river** and the build-up of sediment allows the river to break from its single channel as it nears its mouth. Under these conditions, a river forms a deltaic lobe.

Statement 3 is correct: The **Ganga-Brahmaputra delta is a tide-dominated delta.** It is shaped by the rise and fall of tides in the Bay of Bengal. Tide-dominated deltas usually form in areas with a large tidal range, or area between high tide and low tide.

120. Solution: (b)

Exp) Option b is the correct answer.

Many depositional forms develop within the caves. The chief chemical in limestone is calcium carbonate which is easily soluble in carbonated water (carbon dioxide absorbed rainwater). This calcium carbonate is deposited when the water carrying it evaporates or loses its carbon dioxide as it trickles over rough rock surfaces. **Stalactites, Stalagmites and Pillars are the depositional features found in caves.**

Statement 1 is incorrect: A stalactite (not the stalagmite) is an elongated structure of minerals formed and hanging from the ceilings of caves, hot springs, or man-made structures such as bridges and mines. They are deposited from a solution of minerals in the water, slowly dripping from the ceilings. A stalagmite appears like an inverted stalactite, rising from the floor of a cave.

Statement 2 is correct: There are **four conditions that favor the deposition of the minerals and formation of the stalactite**. They are:

a) a **source of rock above a cave or a cavern,**
b) percolation of water downward, supplied from rain or any other source such as moisture in the wind,
c) a very well regulated, tight but continuous flow of the solution of the mineral and water for determining slow-drip, and
d) proper hollow air space to provide for either evaporation or escape of carbon dioxide from the water, thus, in turn, losing the solvent ability.

Statement 3 is incorrect: The formation of stalactite and stalagmites common in caves and are **found in various region of Indian subcontinent**. One such formation is Shiva Linga inside Borra Caves (Andhra Pradesh), Caves in India's Meghalaya state etc.

The Belum Caves, located in Nandyala district of Andhra Pradesh's Rayalaseema region, is the second largest cave system on the Indian subcontinent, known for its speleothems, such as stalactite and stalagmite formations.

121. Solution: (c)

Exp) Option c is the correct answer.

As groundwater dissolves the **solid rock, it is regarded as a powerful erosional force**. Carbonic acid is particularly effective in dissolving rock limestone. Groundwater moves through minor cracks slowly over many years. The **water dissolves the solid rock and transports it away**, gradually widening the cracks and eventually forming a cave. The dissolved minerals in the solution are carried by groundwater. **This process is termed groundwater erosion.**

Statement 1 is correct: Sinkholes are very common in limestone/karst areas. A sinkhole is an opening more or less circular at the top and funnel-shapped towards the bottom with sizes varying in area from a few sq. m to a hectare and with depth from a less than half a metre to thirty metres or more.

Some of these forms solely through solution action (solution sinks).

Statement 2 is incorrect: Lapies are the **irregular grooves and ridges (not mounds) formed when most of the surfaces of limestone are eaten by solution process (not by deposition of limestones.).** This rugged surface is formed by the solution of rock along with joints and areas of greater solubility by water containing carbonic and humic acids.

Statement 3 is correct: The **collection of multiple smaller individual sinkholes gathers to form a compound sinkhole** called uvala. It denotes a closed karst depression, a terrain form usually of elongated or compound structure and of larger size than of sinkholes. Uvalas are large, irregular, contiguous hollow forms in karst areas.

122. Solution: (d)

Exp) Option d is the correct answer.

Pair 1 is correct. Ventifacts or dreikanter: These are pebbles faceted by sand-blasting and thoroughly polished by wind abrasion. Rock fragments are moved by wind and smoothed on the windward side and another facet is developed if wind direction changes. Such rocks have characteristic flat facets with sharp edges. Amongst the ventifacts, those with three wind-faceted surfaces are called dreikanter form the desert pavement.

Pair 2 is correct. Yardangs are **steep-sided deeply undercut over hanging rock ridges separated from one another** by long grooves or corridors or passageways cut in desert floors of relatively softer rocks. It's size ranges from a metre to kilometre They are usually formed in the areas which are characterized by directional steady winds. They are formed where **alternate bands of hard and soft rocks are vertical or inclined to the horizontal plane**. The intervening beds of softer rocks are abraded and eroded materials are blown away by deflation process. The most characteristic feature of yardangs is their parallelism. They are formed by the action of wind, usually parallel to the wind direction.

Pair 3 is correct. The peneplain is the final stage of his geomorphic cycle of landform evolution. It is gently undulating, almost featureless plain. **It is produced by fluvial erosion** and reduce the land almost to baselevel (sea level), leaving so little gradient that essentially no more erosion could occur.

123. Solution: (c)

Exp) Option c is the correct answer.

A **lagoon** is a shallow body of water protected from a larger body of water (usually the ocean) by sandbars, barrier islands, or coral reefs. It is an elongated narrow saline – water lake. It provides security to coast which is associated with the sea even after its formation. **Such lakes which are found at the conjunction of bars and beaches are known as lagoons.**

When **barrier bars and spits form at the mouth of a bay and block it, a lagoon forms**. The lagoons would gradually get filled up by sediments from the land giving rise to a coastal plain.

Option a is incorrect: When the stream beds turn gentler due to continued erosion, downward cutting becomes less dominant and lateral erosion of banks increases and as a consequence the hills and valleys are reduced to plains. **It does not lead to formation of Lagoon.**

Option b is incorrect: When rivers shift laterally, a series of **natural levees** can form. Natural levees are found along the banks of large rivers. They are low, linear and parallel ridges of coarse deposits along the banks of rivers, quite often cut into individual mounds. **It is not responsible for formation of Lagoon.**

Option d is incorrect: When the waters carrying finer sediments spill over the banks during flooding above the bed, **floodplains are formed. It is not responsible for formation of a Lagoon.**

124. Solution: (b)

Exp) Option b is the correct answer.

The plain landform is mostly formed from materials **deposited by rivers, glaciers, waves and wind**. The type of sediment which constitutes this plain landform has a significant impact on the fertility and economic relevance of the consequent plain formed by deposition.

Statement 1 is incorrect: An **outwash plain** is a plain formed by the **sedimentary deposits by a glacier when it melts**, while the alluvial plains are caused by the weathering that is caused by the water currents in the seas, river or lakes. This water flows down the higher lands, to regions that have low land.

Alluvial plains are formed by the **deposition of sediments** called alluvium. An alluvial plain usually includes floodplains as part of its area but extends beyond such plains. As a river flows down mountains or hills, it carries sediments resulting from erosion and transports the sediments to the lower plain. As the sediments build up over time, the elevation of the floodplain increases while the width of the river channel decreases. Unable to bear the pressure, the river now looks for an alternative course with a higher channel capacity. Thus, the river forms a meander and flows through a new channel. In this way, floodplains continue growing and adding up to form massive stretches of alluvial plains.

Statement 2 is correct: Alluvial plains are the **most fertile soil** because it has a loamy texture (contain sand, clay and slit) and is rich in humus, contains organic nutrients. A granular material composed of finely divided rock and mineral particles are called sand. Sand with clay and slit helps to increase fertility of alluvial soil. **Outwash plains are infertile**. It consists of gravel, silt, sand and clay.

125. Solution: (d)

Exp) Option d is the correct answer.

Karst is a landscape which is underlain by limestone which has been eroded by dissolution, producing towers, fissures, sinkholes, etc. It is so named after a province of Yugoslavia on the Adriatic Sea coast where such formations are most noticeable.

Statement 1 is correct: Karst is a type of landscape where the **dissolving of the bedrock** has created sinkholes, sinking streams, caves, springs, and other characteristic features. Karst is associated with soluble rock types such as **limestone**, marble, and gypsum. It results from the excavating effects of underground water on massive soluble limestone.

Statement 2 is correct: In karst region, there is a general absence of surface drainage as most of the surface water has gone underground. Limestones are well jointed and it is through these joints and cracks that rain-water finds its way into the underlying rock. Progressive widening by solution enlarges these cracks into trenches and a most intriguing feature called limestone pavement is developed. The enlarged joints are called grikes and the isolated, rectangular blocks are termed clints.

Statement 3 is correct: The karst environment provides the main raw material used in the manufacture of cement (limestone). Carbonate rocks found within the karst formations are also used as raw materials for a number of other purposes in a variety of industrial sectors

126. Solution: (c)

Exp) Option c is the correct answer.

Sand dunes are mounds formed by loose grains of sand blown by the wind and gathered in one place creating a small hill. Sand dunes cannot be formed without sand and wind. Most sand dunes form in deserts and sandy beaches. Subsequently, the five major types of sand dunes are Star, linear, parabolic, barchan, and reversing sand dunes.

Pair 1 is correctly matched: A barchan sand dune is a **crescent-shaped dune**. It has a steep slip face whose tips point away from the wind. The dunes are separated from each other and keep moving along the surface of the barren deserts.

Pair 2 is incorrectly matched: Linear sand dunes are the **longest type of sand dunes in the world**. They are **straight, regular-spaced, and snake-like in shape**. A prominent feature of the linear sand dunes is the ridges. The dunes appear as isolated and large symmetrical peaks.

Whereas, Star dunes have **pointed ridges and slip faces on at least three sides**. Star dunes develop where winds come from many different directions.

Pair 3 is correctly matched: Dome dunes are the rarest type of dune. They are **circular and do not have a slip face.** The wind can blow material onto the dune from any side.

Pair 4 is correctly matched: U-shaped mounds of sand with convex noses trailed by elongated arms are parabolic dunes. A parabolic sand dune is an **inverted crescent-shaped dune** that has vegetation-anchored tips. The tips of the parabolic dune point towards the upwind direction. On the other hand, its steep slip face points to the downwind side.

127. Solution: (b)

Exp) Option b is the correct answer.

In large flood and delta plains, rivers rarely flow in straight courses. Loop-like channel patterns called meanders develop over flood and delta plains.

Statement 1 is incorrect: Meander is **not a landform but is only a type of channel pattern.** Meanders are associated with the rivers in the **middle and mature stage of the river**, especially in the **plain region.** Usually, the energy accompanying flow water in a river decreases progressively from the upper course of the river to the lowest course of the river.

Statement 2 is correct: Meanders are the result of **both erosional and depositional processes.** It is produced as a watercourse erodes the sediments of an outer, concave bank (cut bank) and deposits sediments on an inner, convex bank which is typically a point bar.

128. Solution: (c)

Exp) Option c is the correct answer.

Streams are one of the most effective surface agents that erode rock and sediment. In addition to eroding the bedrock and previously deposited sediments along its route, a stream constantly abrades and weathers the individual rock and soil particles carried by its water. Hydraulic action, abrasion, and solution are the three main ways that streams erode the earth's surface.

Statement 1 is correct: Hydraulic action is the **mechanical loosening and removal of the material from the rocks due to pressure exerted by the running water.** The higher the velocity the greater is the pressure of the running water and hence greater is its capacity to bodily move out parts of the rock or grains of soil from the parent body occurring along its base or sides.

Statement 2 is incorrect: Abrasion is the **process by which a stream's irregular bed is smoothed by the constant friction** and scouring impact of rock fragments, gravel, and sediment carried in the water. The individual particles of sediment also collide as they are transported, breaking them down into smaller particles.

Statement 3 is correct: The **slow but steady chemical action of the stream water** on the rocks is expresses by the term corrosion. The extent of corrosion depends such on the composition of rocks and also on the composition of flowing water. Thus, all rocks are not equally susceptible to corrosive action of stream water. Limestones, gypsum and rock salt bodies are soluble in water to varying degrees.

Statement 4 is incorrect: Attrition is used for **wear and tear of the load sediments being transported by a moving natural agency** through the **process of mutual impacts and collisions** which they suffer during their transport.

129. Solution: (d)

Exp) Option d is the correct answer.

Coastal deposition is when the sea drops or deposits material. This can include sand, sediment, and shingle, resulting in landforms of coastal deposition. Bars, barriers and beaches are the depositional features of coasts. They have various significance for marine as well as human life.

Statement 1 is correct: A ridge of sand and shingle formed in the sea in the off-shore zone (from the position of low tide waterline to seaward) lying approximately parallel to the coast is called an off-shore bar. The coastal off-shore bars offer the **first buffer or defence against storm or tsunami** by absorbing most of their destructive force.

Statement 2 is correct: Barrier islands are a type of island made up of long stretches of sand that are parallel to the mainland. Barrier islands offer an **important habitat for a wide variety of fish, shellfish, sea bird and sea turtle species.** The ecosystems which develop around barrier islands are unique in many respects. Sea turtles, for example, use the ocean-facing beaches of barrier islands to nest.

Statement 3 is correct: Beaches are characteristic of shorelines that are dominated by deposition, but may occur as patches along even the rugged shores. Beaches assist **in the protection of coastal structures** from destruction from storms. The beach also protects the **upland structures by forming storm bars**, which prevent storms from breaking into the upland. It helps to **protect the coastal structures** by creating enough space for the ocean current energy to dissipate.

130. Solution: (b)

Exp) Option b is the correct answer.

Bajada is a **broad slope of debris** spread along the lower slopes of mountains by descending streams, usually found in arid or semiarid climates. It may be formed by the **coalescence of a series of adjacent Alluvial Cones.** A bajada is usually composed of gravelly alluvium and may even have large boulders interbedded in it.

Gently sloping depositional plain between pediments and playa is called bajada. Bajada is formed due to coalescence of several alluvial fans. Thus, **bajada is a wholly depositional feature.** The slope in its upper part ranges between 8° and 10° but it becomes 1° in its lowermost portion touching the playa.

131. Solution: (a)

Exp) Option a is the correct answer.

Ground water is tapped from the sub-surface rock layers by means of wells.

Statement 1 is correct: In Artesian wells, the aquifer(water) is trapped between impermeable rock on both top and bottom. In between these two impermeable layers is the permeable layer, where water is stored. If an artificial

hole is made to the porous rock, the water comes out like a fountain. These are called Artesian wells.

Statement 2 is correct: Dug wells are excavated by hand shovel to below the water table. The well is lined with stones, bricks, and tile to prevent collapse. These wells are able to obtain water from less-permeable materials such as very fine sand, silt, or clay. **They are shallow and are subject to contamination from nearby surface sources.** Hand-driven wells usually are only around 30 feet deep.

Statement 3 is incorrect: In Artesian well, the water is trapped under intense pressure. This intense pressure forces the water in basin to the surface like a fountain. In general, there is no requirement to pump the water as the pressure is too high.

132. Solution: (b)

Exp) Option b is the correct Answer.

When rocks undergo weathering, some minerals are removed through chemical/ physical leaching by groundwater, thereby increasing the concentration of remaining (valuable) minerals.

Weathering can be classified as – physical, chemical, and biological, whereas Chemical weathering can be due to solution, carbonation, hydration, or oxidation/reduction.

Statement 1 is correct: Carbonation is the process in which atmospheric carbon dioxide leads to solution weathering. Carbonation occurs on rocks that contain calcium carbonates such as limestone and chalk. This **process speeds up with a decrease in temperature** and therefore is a large feature of glacial weathering as carbon dioxide is more soluble at lower as opposed to higher temperatures.

Statement 2 is correct: In the process of oxidation, chemical weathering works on rocks that contain iron. These rocks turn to rust in the process. As rust expands, it weakens rock and helps break it apart. Oxidation occurs where there is ready access to the atmosphere and oxygenated waters. The minerals most commonly involved in this process are iron, manganese, sulphur etc. In the process of oxidation rock breakdown occurs due to the disturbance caused by addition of oxygen.

Statement 3 is incorrect: Hydrolysis is any chemical reaction in which a molecule of **water breaks one or more chemical bonds.** Minerals take up water and expand; this expansion causes an **increase in the volume of the material itself or rock.** Calcium sulphate takes in water and turns to gypsum, which is more unstable than calcium sulphate. This process is reversible and long, continued repetition of this process causes fatigue in the rocks and may lead to their disintegration.

Statement 4 is incorrect: Under the soil cover, chemical weathering of rock becomes **enhanced and fast.** This is because the soil absorbs rainwater and keep the under lying rock in contact with the moisture. The rainwater absorbs organic acids from the soil and thus becomes a stronger weathering agent than pure rainwater acting on bare rock.

Important Tips

Chemical Weathering changes the molecular structure of rocks and soil. It involves multiple modes like Solution, Carbonation, Oxidation, and Reduction, etc. Sometimes, it dissolves large portions of limestone or other rock on the surface of the Earth to form a landscape called karst. One of the world's best examples of karst is the Stone Forest, near Kunming, China.

133. Solution: (c)

Exp) option c is the correct answer.

The rock and soil materials transported by erosion processes are eventually deposited in the sea, although they may be temporarily deposited in other locations such as below cliff faces (e.g., as screes), on hillsides (e.g., as colluvium) beside rivers (e.g., as flood plains), in lakes (e.g., as deltas), or on desert plains (e.g., sand dunes).

Option c is correct. Screes: Scree is a collection of broken rock fragments at the base of a cliff or other steep rocky mass that has accumulated through periodic rock falls. The term scree is applied both to an unstable steep mountain slope composed of rock fragments and other debris and to the mixture of rock fragments and debris itself. It is result of physical and chemical weathering acting on a rock face.

Option a is incorrect. Pyroclast: A pyroclastic flow is a dense, fast-moving flow of solidified lava pieces, volcanic ash, and hot gases. It occurs as part of certain volcanic eruptions. A pyroclastic flow is extremely hot, burning anything in its path.

Option b is incorrect. Colluvium: Soil transported by the gravitational force is called Colluvium soil. Colluvium is a type of matrix material that has been moved downslope because of gravity. Colluvium is a heterogeneous, unsorted material of all particle sizes (from boulders to clay) that requires relatively little abrasion to round the particles. As a result, colluvium consists of very sharp and angular rock fragments that accumulate at the bottom of steep slopes.

Option d is incorrect. Sand dunes: A sand dune is any hill of loose sand shaped by the wind. Dunes are one of the most common types of eolian landforms.

134. Solution: (d)

Exp) option d is the correct Answer

Weathering denotes the process of wearing, breaking up, and fragmentation of the rock that creates the surface of the ground and that remains exposed to the weather. The process results from forces of weather like rain action, variations in temperature, and frost action.

Statement 1 is correct: Weathering helps in soil enrichment. Without weathering, the concentration of the same valuable material may not be sufficient and economically viable to exploit, process, and refine. This is what is called enrichment.

Statement 2 is correct: Weathering is the initial stage in the formation of soil. It produces other natural resources, for instance, clay which is used for making bricks. Another significance is weathering weakens rocks making them

easier for people to exploit, for example, by mining and quarrying. This process is accountable for the fragmentation of the rocks into smaller fragments and making the way for the creation of not only soils and regolith, but also mass movements and erosion.

Statement 3 is correct: It aids erosion, mass wasting, reduction of relief, and modifications in landforms. Weathering of rocks helps in the augmentation and concentrations of some ores of manganese, aluminium, iron, copper, etc. which have a great demand in the economy of the country.

135. Solution: (c)

Exp) Option c is the correct answer.

The rain water flows either as run off that generates streams which combine together to form a river or percolates down to form Groundwater. The Groundwater accounts for approximately 22% of the world's supply of fresh water. The source of groundwater is rainfall and snow melt.

Statement 1 is incorrect: Water percolates from the soil moisture zone through the unsaturated zone to the water table. This **Unsaturated zone is called as Vadose zone. At vadose zone the pores contain some air. The water is present in the zone**. The zone is situated at shallow depth and is above the water table.

Statement 2 is correct: The phreatic zone is situated below the water table, in which relatively all pores and fractures are saturated with water. The phreatic zone size, color, and depth may fluctuate with changes of season, and during wet and dry periods.

Statement 3 is correct: At the boundary between Vadose zone and Phreatic zone is the groundwater table, usually called water table. **The water table is a surface that marks the upper limit of the zone of saturation.**

136. Solution: (c)

Exp) Option c is the correct answer.

Exfoliation is a process in which sheets of rock fracture and are detached from the outcrop due to pressure release.

Statement 1 is correct: large variations in temperature, are credited with producing exfoliation. The expansion from heating during the day followed by contraction from rapid cooling at night cause the separation of thin slabs from large blocks of rock at the surface. Various minerals in rocks possess their own limits of expansion and contraction. With rise in temperature, every mineral expands and pushes against its neighbour and as temperature falls, a corresponding contraction takes place. This results in weathering process of exfoliation.

Statement 2 is incorrect: Exfoliation is a type of mechanical weathering; it is also known as onion weathering. Exfoliation refers to peeling off concentric shells of rocks due to the combined actions of heat and wind in hot arid and semi-arid regions and monsoon lands. Exfoliation is more common over crystalline rocks. It **does not occur due to combined effect of chemical or biological weathering**.

Statement 3 is correct: When the sheets of rock break away from the exposed rocks along the fractures, this process is known as exfoliation. And **thus, Exfoliation due to pressure release is also known as sheeting.**

137. Solution: (c)

Exp) Option c is the correct answer

Mass wasting occurs when a slope is too steep to remain stable with existing material and conditions.

Option 1 is correct: Undercutting of a slope reduces the slope's resistance to the force of gravity by removing much-needed support at the base of the slope. Alternating cycles of freeze and thaw can result in a slow, virtually imperceptible loosening of rock, thereby weakening the rock and making it susceptible to slope failure.

Option 2 is correct: Vegetation removal can trigger mass wasting. Vegetation stabilizes soil. When it is removed from a slope the slope is vulnerable to water and wind erosion. The plant roots bind the soil and rocks together.

Option 3 is correct: Heavy rains can saturate regolith (the layer of unconsolidated solid material) reducing grain to grain contact and reducing the angle of repose, thus triggering a mass movement. Heavy rains can also saturate rock and increase its weight. Excessive precipitation is the most common trigger of landslides.

Option 4 is incorrect: Animals movements are not of that magnitude that can cause mass movement.

138. Solution: (b)

Exp) Option b is the correct answer.

Landslides may be caused by natural factors such as heavy rain, snowfall, earthquake, or it may be induced by human factors like over-interference with the slope-stability by deforestation, unplanned construction, or mining.

Option 1 and 4 are correct: Isostatic Equilibrium means that the Earth's surface is in equilibrium when the buoyancy force of the mantle, pushing up on the lithosphere, is equal to the gravitational force pushing down on it. **Himalayas have relatively younger age and has not thus achieved the Isostatic Equilibrium** which frequently causes the landslides.

Option 2 is correct: Diurnal changes of temperature are much more in northern India. This weakens the rocks and aids mass wasting causing landslides.

Option 3 is incorrect: Himalayas are made of sedimentary rocks (not igneous rocks) which can easily be eroded. These rocks are more susceptible to denudation and erosion and thus can cause landslides. Also, **igneous rocks are hard** and are not very susceptible for erosion.

139. Solution: (a)

Exp) Option a is the correct answer.

Valleys, defined as elongated depression between hills or mountains, exhibit remarkable diversity in their dimensions and shapes. This variety allows us to identify and categorise them into distinct types such as gorges, canyons etc. each with its own unique characteristics.

Statement-I is correct: A gorge comprises a deep valley featuring extremely steep to vertical sides, while a canyon is distinguished by steep, terraced side slopes and can reach comparable depths as a gorge. **A gorge is almost equal in width at its top as well as its bottom. Conversely, the canyon is wider at its top than at its bottom.**

Statement-II is correct: Canyons are commonly formed in sedimentary rocks that are horizontally layered. Erosion can easily carve through these layers creating steep step-like side slopes. **Gorges**, on the other hand, usually form in hard rocks such as granite or basalt which leads to very steep slopes.

140. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: Cirques are bowl-shaped depressions formed at the head of a glacier or valley by the erosive action of a glacier. As the ice moves downhill, it **plucks and abrades the bedrock**, gradually creating these bowl-shaped depressions known as Cirques.

Option b is incorrect: Hanging valleys are smaller valleys that are left 'hanging' above the main valley, often formed due to the **differential erosion of tributary glaciers with respect to the main glacier**.

Option c is incorrect: An **arete** is a narrow, **sharp-edged ridge formed between two cirques** due to erosion by glaciers on either side.

Option d is incorrect: Roche moutonnée refers to a **rock smoothed and polished by the passage of a glacier. It** typically has a gently sloping side that faces the direction of the glacier's movement and a steep side that faces away.

141. Solution: (a)

Exp) Option a is the correct answer.

Desert landscapes exhibit various landforms shaped by both erosional and depositional processes. These formations result from the interaction between wind, water (although sparse), temperature fluctuations, and the minimal vegetation cover.

Option 1 is correct: Barchan dunes are crescent-shaped sand dunes formed by wind deposition. These dunes move slowly across the desert surface due to prevailing winds, and they are considered depositional landforms. They are created by the accumulation of wind-blown sand.

Option 2 is incorrect: Mushroom refers to mushroom rocks or rock pedestals found in deserts. These structures are **formed by erosional processes** rather than deposition. They result from differential erosion where softer rock erodes away faster than more resistant layers, creating pedestal-like formations. Thus, mushroom rocks are primarily erosional features.

Option 3 is incorrect: Gently inclined rocky floors close to the mountains at their foot with or without a thin cover of debris, are called **pediments**. Such rocky floors **form through the erosion of mountain front through a combination of lateral erosion by streams and sheet flooding.**

Option 4 is incorrect: Inselbergs are isolated and steep-sided hills or mountains that stand prominently amidst a flat desert landscape. These formations are **primarily erosional landforms**, created by the differential erosion of surrounding softer rock, leaving behind more resistant rock formations.

142. Solution: (b)

Exp) Option b is the correct answer.

Any limestone or dolomitic region showing typical landforms produced by the action of groundwater through the processes of solution and deposition is called Karst topography. It refers to a geological area primarily composed of limestone, which is alternatively known as chalk or calcium carbonate. As limestone is a relatively softer rock, it erodes when rainwater seeps into the rock.

Option 1 is incorrect: Although Karst regions can be found in various climatic zones, from arid to humid, and from cold to hot, it is **more pronounced in regions where there is a high rainfall and dissolution**. On the other hand, in **arid** regions, karst features may be **less pronounced due to low rainfall and high evaporation.** Thus, **scarce rainfall limits the formation** of Karst topography.

Option 2 is correct: Less vegetation cover can contribute to faster water infiltration and increased exposure of soluble rocks to dissolving water, thus promoting karst formation.

Option 3 is correct: The primary requirement of Karst formation is the **presence of soluble rocks like limestone, dolomite, or gypsum**. These rocks **dissolve readily in water** containing carbonic acid, a weak acid formed by the combination of carbon dioxide and water, leading to karst topography.

143. Solution: (b)

Exp) Option b is the correct answer.

Glacial valleys and river valleys are two distinct landforms shaped by different geological processes. The formation and characteristics of these valleys are a result of the erosional forces exerted by glaciers and rivers, leading to unique topography.

Statement 1 is incorrect: Glaciated valleys are trough-like and U-shaped with broad floors and relatively smooth, and steep sides. Erosion and compression are two main forces that give U-shape to glacier valleys- compression due to the sheer mass of the glacier that results in even distribution of the load, and erosion that excavates huge amounts of loose soil and rock. Other factors that contribute to the formation of U-shaped valleys include abrasion, freeze-thaw weathering effect, movement of glaciers, etc.

River valleys generally exhibit a V-shaped profile. The erosive action of rivers, characterized by processes like abrasion and hydraulic action, **carves a narrower, deeper channel with more gently sloping sides.**

Statement 2 is correct: Hanging valleys are associated with glacial valleys. **Hanging valleys are smaller valleys that intersect a main glacial valley at a higher elevation.**

While one of the landforms found in river valley is a 'meander'. **Meanders are the sinuous bends in the river's course formed by lateral erosion.**

144. Solution: (d)

Exp) Option d is the correct answer.

Fjords are long, narrow, deep inlets of the sea that are typically framed by steep cliffs or mountains. These distinctive geographical features are **formed through the complex interaction of glacial and marine processes.** The formation of a fjord typically involves the following processes:

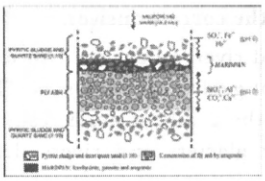
1) **Glacial Erosion**: Fjords are often created by the erosion of valleys by glaciers. As glaciers move downhill, they exert tremendous pressure on the underlying rocks, carving out U-shaped valleys. This glacial erosion creates deep and steep-sided troughs.
2) **Glacial Retreat:** Over time, as climate conditions change, glaciers may begin to retreat. As **the glacier withdraws, it leaves behind the U-shaped valley it carved.**
3) **Sea Inundation**: **The U-shaped valley, now open to the sea, becomes inundated with seawater.** The ocean fills the depression left by the retreating glacier, creating a deep, narrow inlet with steep sides, known as fjord.

Fjords are found mainly in Norway, Chile, New Zealand, Canada, Greenland, and the U.S. state of Alaska.

145. Solution: (d)

Exp) Option d is the correct answer.

Hardpans are **dense, compacted layers of soil** that are **difficult for water and roots to penetrate**. They are typically found **below the topsoil layer** and **can be several inches or even feet thick.**



Option a is incorrect- Over time, the **weight of overlying layers of soil and rock** can cause soil particles to be compacted together, forming a hardpan.

Option b is incorrect- Human activities such as **driving heavy machinery over the soil or tilling the soil too deeply can cause soil particles to be compressed and compacted together**, forming a hardpan.

Option c is incorrect- Chemical reactions, such as those that occur when soil is exposed to high levels of **calcium or iron, can cause soil particles to bind together,** forming a hardpan.

Option d is correct- While excessive watering can lead to **temporary soil compaction**, it is not a primary cause of hardpan formation. Hardpans are typically formed by processes that cause soil particles to bind together or to become tightly packed.

146. Solution: (b)

Exp) Option b is the correct answer.

Diastrophism refers to the broad category of geological processes involving the deformation, movement, and alteration of the Earth's crust, leading to changes in its shape, structure, and relief features. This includes phenomena such as tectonic plate movements, mountain building, folding, faulting, and other crustal adjustments over geological time scales.

Let us evaluate each events mentioned:

Option 1 is correct: Orogenic events involve the processes of mountain building, typically resulting from the collision of tectonic plates or the subduction of one plate beneath another. **These events often include folding, faulting, and uplift of large crustal segments. Hence, Orogenic or Mountain Building processes are examples of diastrophism.**

Option 2 is correct: Minor earthquakes often **result from movement along faults, which are fractures in the Earth's crust. Faulting is a diastrophic process,** as it involves the breaking and displacement of rock layers due to tectonic forces. Hence, **Minor earthquake events can be included under the phenomenon of Diastrophism.**

Option 3 is correct: The uplift of plateaus is often **a result of epeirogeny movements or hotspot activity,** both of which are considered diastrophism. Therefore, **uplift of plateaus is included in diastrophism.**

Option 4 is incorrect: Mass Wasting is the downhill movement of rock and soil under the influence of gravity. While **Mass Wasting alters** the landscape, **it is typically a localized and surface-related process and does not involve deep seated crustal movements in the earth and hence is not included under the phenomenon of diastrophism.**

147. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Weathering is an in-situ process, occurring on-site with no or minimal material movement. Unlike erosion, which transports weathered materials, weathering involves forces like temperature changes, chemical reactions, and biological activity **directly affecting rocks and minerals where they are situated. The resulting broken-down materials accumulate on-site, forming soil and regolith, with minimal movement**, in contrast to the more extensive material transport seen in erosion processes.

Statement 2 is correct: Weathering is faster in humid climates due to abundant water, a universal solvent that accelerates chemical reactions and facilitates mineral dissolution. Higher biological activity, temperature fluctuations, and enhanced transportation of weathered material in humid environments contribute to the increased breakdown of rocks **compared to dry climates with limited water availability.**

148. Solution: (b)

Exp) Option b is the correct answer.

Weather plays a crucial role in **triggering and influencing mass movements on Earth's surface** due to its significant impact on factors that contribute to **slope stability. Mass movements**, also known as **mass wasting**, encompass the **downslope movement of soil, rock, and other debris under the influence of gravity**. Weather conditions, particularly **precipitation**, can significantly **alter the balance of forces acting on slopes, increasing the likelihood of downslope movement**.

Statement 1 is incorrect- Mass movement and erosion are separate geomorphic processes distinguished by their **mechanisms and outcomes**. Unlike erosion, mass movement **does not involve active transport by air, water, or ice;** instead, **the debris may carry these elements with it. Hence, weathering and erosion processes are not essential for mass movement though they may help mass movements.**

Statement 2 is correct- Gravity facilitates mass movements, with **no involvement of any other geomorphic agents** like **running water, glaciers, wind, waves, or currents** in the process.

Statement 3 is correct- Solifluction is a type of **mass movement characterized by the slow downslope flow of water-saturated or lubricated soil mass and fine-grained rock debris**. This phenomenon is essentially a **form of creep**, where the movement is facilitated by the **presence of lubricating water**. It is prominently observed in **permafrost zones,** where groundwater strata are situated between permanently frozen soil and rocks, contributing to the gradual downslope motion typical of solifluction.

149. Solution: (d)

Exp) Option d is the correct answer.

A landslide is a **downward and outward movement of slope-forming materials**, such as **rock, soil, and vegetation,** that occurs on various inclines. Landslides can range in size from **small rockfalls to enormous debris flows** that can travel for miles. They are triggered by a combination of factors, including **gravitational forces, heavy rainfall, snowmelt, earthquakes, and volcanic eruptions**.

Option a is incorrect- A **'debris slide', also known as a rapid mass movement**, is a geological phenomenon that involves the **swift rolling or gliding of earth debris without backward rotation**. Debris slides typically occur on **steep slopes**, often following **heavy rainfall or snowmelt**, and can travel at speeds of up to **60 miles per hour.** They are characterized by their **high mobility and ability to transport large amounts of material over long distances.**

Option b is incorrect- 'Debris falls' involves virtually unrestricted descent of earth debris from a vertical or overhanging face. Debris falls are often triggered by factors such as weathering, erosion, undercutting, or seismic activity.

Option c is incorrect- 'Rock falls' involve the glide of individual rock masses along bedding, joint, or fault surfaces. This type of mass wasting occurs when a **block of rock becomes detached from a cliff or steep slope and falls freely through the air**. Rock falls can be caused by a variety of factors, including weathering, erosion, undercutting, and seismic activity.

Option d is correct- 'Slump' is a type of mass wasting that involves the Slip of one or multiple rock debris units with a reverse rotation. Slumps are typically triggered by factors such as **heavy rainfall, snowmelt, or earthquakes.** They can occur in a variety of environments, including mountains, hills, and cliffs.

150. Solution: (b)

Exp) Option b is the correct Answer

Biological weathering is contribution to or removal of minerals and ions from the weathering environment and physical changes due to growth or movement of organisms.

Types of Biological Weathering

Option 1 is correct: Burrowing animals: Some animals, such as moles, squirrels, and rabbits, can create fissures in rocks. These animals, however, suck up the nutrients from the rock by creating a fissure. It gradually breaks the rock into large chunks.

Option 2 is correct: Microbial activity: Organic acids are produced by microscopic organisms such as algae, moss, lichens, and bacteria. This changes the chemical composition of the rock and gradually erodes its outer layer.

Option 3 is incorrect: Cryofracturing is caused **by water,** in either liquid or solid form, is often a key agent of **mechanical weathering**. For instance, liquid water can seep into cracks and crevices in rock. If temperatures drop low enough, the **water will freeze**. When water freezes, it expands. The ice then works as a wedge. It slowly **widens the cracks** and splits the rock. When ice melts, liquid water performs the **act of erosion** by carrying away the tiny rock fragments lost in the split. This specific process (the freeze-thaw cycle) is called frost weathering or cryofracturing.

Option 4 is incorrect: Exfoliation is caused due to thermal stress. Temperature changes can also contribute to mechanical weathering in a process called thermal stress. Changes in temperature cause rock to expand (with heat) and contract (with cold). Rocky desert landscapes are particularly vulnerable to thermal stress.

151. Solution: (b)

Exp) Option b is the correct answer.

Dykes are vertical wall-like structures formed when lava solidifies perpendicular to the ground through cracks and fissures. They are intrusive volcanic landforms resulting from magma or lava filling fractures in the Earth's crust. **Dykes play a significant role as conduits for the upward movement of molten rock.** This process leads to the development of vertical, wall-like structures that cut across existing rock formations. These are the most commonly found intrusive forms in the western Maharashtra area. These are seen as the conduits supplying magma for the eruptions that contributed to the Deccan traps' formation.

152. Solution: (c)

Exp) Option c is the correct answer.

Hydration is the chemical addition of water. Minerals take up water and expand; this expansion causes an increase in

the volume of the material itself or rock. Calcium sulphate takes in water and turns to gypsum, which is more unstable than calcium sulphate. This process is reversible and long, continued repetition of this process causes fatigue in the rocks and may lead to their disintegration.

153. Solution: (b)

Exp) Option b is the correct answer.

Stalactites and stalagmites are both mineral formations that grow in caves, but they have different shapes and locations. A stalactite is a pointed, icicle-like formation that hangs from the ceiling of a cave. A stalagmite is a rounded, cone-like formation that rises from the floor of a cave.

Statement I is correct: The Amarnath lingam of Lord Shiva is a natural **ice stalagmite** which is believed to wax and wane with the Moon's cycle. **Ice stalagmites** are either seasonal or permanent in nature and **are found in cave environments where the temperature is below the freezing point of water.** Ice stalagmite might form **when water vapor in the cave environment freezes or when surface water enters the cave via cracks or openings on the surface, falls on the cave floor, and freezes to form an ice stalagmite.**

Statement II is correct: Limestone stalagmites are the most common form of stalagmites found growing from the ground of limestone caves. They are formed of calcium carbonate or other mineral deposits that precipitate out from mineralized water flowing in the cave environment. Stalagmites in limestone caves take thousands of years to attain a significant length.

Hence, statement II does not correctly explain statement I: The **Amarnath Lingam's formation is not a limestone stalagmite. It is an ice stalagmite formed when water vapors or water through cracks or openings falling on the cave floor freezes. It is not formed due to precipitation of carbonate minerals.**

154. Solution: (a)

Exp) Option a is the correct answer.

Submergent coastlines occur due to the sinking of the land or the rise of the sea. On the other hand, Emergent coastlines, though less common, occur due to land uplift or sea level decline.

During the Ice Age, much of the Earth's water was locked in ice. As the climate warmed, this ice melted, **leading to a significant rise in sea levels**, estimated to be nearly 300 feet in some areas. In upland coastal regions, **the rising sea level submerged lower valleys**, creating long, narrow branching inlets separated by narrow headlands. These formations are characteristic of **Ria coasts,** found along the Atlantic coastline in regions like northwest France, northwest Spain, southwest Ireland, Devon, and Cornwall.

The **Dalmatian** coast are the **longitudinal coasts formed due to the submergence of mountains running parallel or concordant to the seacoasts.** The Coast of Dalmatia, Yugoslavia, along the Adriatic Sea is a typical example.

Estuarine coasts are submerged coasts where river mouths become drowned, forming funnel-shaped estuaries. If these estuaries are not silted by moving sandbanks, they create excellent sites for ports. Examples include the Thames, Elbe, and Plate estuaries, which are home to major seaports like London, Hamburg, and Buenos Aires. Tidal effects further enhance the value of these ports, and modern dredges help to keep them open continuously, even with some silting.

Important Tips

Emergent Coastlines are formed by an upliftment of the land or by lowering of the sea level. Depositional landforms are common in the coastline of emergence and some features of these coasts are spits, lagoons, beaches, cliffs, etc. The Eastern coast of India (Coromandel coast) is an example of a coastline of emergence.

Fault coastlines are formed when downthrown blocks along a fault are submerged, leaving the uplifted block with its steep side facing the sea.

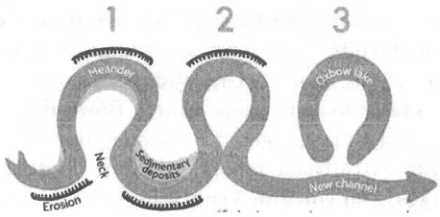
Compound coastlines are the formation of two coastlines, such as submergence followed by

emergence or vice versa. The coastlines of Norway and Sweden are typical examples of compound coastlines.

155. Solution: (b)

Exp) Option b is the correct answer.

An oxbow lake is a U-shaped body of water that forms when a meandering river or stream erodes through a narrow neck of land, cutting off a meander loop and creating a free-standing body of water. They are often curved or horseshoe-shaped and are common features in floodplains and lowland areas. They are still water lakes without inflow or outflow, often drying up over time.



Statement 1 is incorrect: Ox-bow lakes are typically formed during the mature stage of a river. During the young stage, rivers often exhibit a straighter path with high energy levels, making it less likely for meander loops to form. As rivers mature, they develop meandering tendencies due to a decrease in slope and increased lateral erosion. It's during this stage that meander loops form and oxbow lakes are eventually created when the river cuts through the meander neck.

Statement 2 is correct: Oxbow lakes are formed through a combination of erosion and deposition by the river. Erosion occurs on the outer (concave) bank of a meander loop as the river flows and cuts into the bank, widening the loop. Deposition occurs on the inner (convex) bank where sediment is deposited, leading to the formation of a point bar. Over time, the erosion on the outer bank increases, and the meander neck narrows until the river cuts through, creating a separate oxbow lake.

Statement 3 is correct: The Kabartal Wetland, also known as Kanwar Lake locally, stands as Asia largest oxbow lake and is located in Bihar's Begusarai district. It forms as a residual oxbow lake resulting from the meandering of the Gandak River, a tributary of the Ganga. Encompassing a significant portion of the Indo-Gangetic plains in northern Bihar, this lake attained Ramsar site status in 2020, marking it as Bihar's first wetland to join the Ramsar convention.

Important Tips

Vynthala lake: Vynthala Lake is a prominent and the only natural oxbow lake of south India, located in the Thrissur district of Kerala, India. It is situated near the town of Chalakudy and is formed by the meandering course of the Chalakudy River.

156. Solution: (c)

Exp) Option c is the correct answer.

A delta forms where a river meets the sea, as the river deposits its fine sediment at its mouth, creating a fan-shaped alluvial area. Deltas grow rapidly both sideways and seawards due to the continuous accumulation of sediment. Some deltas, like the Ganges delta, are vast, almost as big as the whole of West Malaysia.

Statement 1 is correct: Active vertical and lateral erosion in the upper course of the river is essential for formation of deltas, because it ensures that the river is constantly **breaking down rocks and transporting sediment downstream.**

Statement 2 is correct: The **shallowness of the sea adjacent to the delta is ideal for sediment accumulation.** If the sea is too deep, sediment carried by the river might disperse, hindering delta formation. Shallow seas retain sediment, promoting delta formation.

Statement 3 is correct: Large lakes along the river's path can act as sediment traps, preventing sediment from reaching the sea and forming a delta. Hence with the absence of such large lakes, rivers can transport their sediment more effectively towards the coast, promoting delta formation.

Statement 4 is incorrect: Strong Ocean currents perpendicular to the river mouth can disrupt the deposition of sediment, washing it away before it can accumulate and form a delta. Thus, the absence of any such strong current in the Coast, allows sediment to settle and build up over time, shaping the delta landscape effectively.

157. Solution: (b)

Exp) option b is the correct answer.

Depositional landforms of glaciers result from the accumulation and deposition of sediments carried by glacial ice. As glaciers move, they transport a wide range of sediments, including rocks, gravel, sand, and clay. When the glacier's velocity decreases, either due to a decrease in slope or a decrease in ice volume, it deposits these sediments, forming various landforms. Examples include; **Moraines, outwash plains, drumlins, eskers, kames, and glacial till etc.**

Option 1 is correct: An **Outwash plain** is a **depositional glacial landform.** It is a flat area of sediment, **made up of fluvio- glacial deposits** washed out from the terminal moraines by the streams and channels of the stagnant ice mass. The material carried by the glaciers is arranged and redeposited in various forms across different landscapes, ranging from low hilly heathlands like the Luneburg Heath of the North European Plain, to undulating plains. Here, terraces, alluvial fans, and deltaic deposits formed by the streams of meltwater contribute to the diverse terrain.

Option 2 is correct: Moraine is a **depositional glacial landform.** It is made up of rock fragments shattered by frost action, embedded in glaciers, and transported down valleys. Those that fall on the sides of glaciers, mainly screes, are called **lateral moraines.** When two glaciers merge, their inside lateral moraines combine to form a **medial moraine.** Rock fragments dragged beneath the ice are deposited as **ground moraine** upon glacier melting, spreading across the valley floor. The glacier eventually melts upon reaching the valley's foot, leaving behind a pile of transported materials known as the **terminal moraine or end moraine.** The deposition of end moraines may occur in successive waves as the glacier retreats, forming **recessional moraines.**

Option 3 is correct: **Kame** is a small, steep-sided mound or hill composed of sand, gravel and till, that accumulates in a depression on the surface of a glacier. It forms when sediment accumulates in openings in the ice or as a result of sediment being carried by meltwater streams and deposited on the glacier's surface. It is also a **depositional landform.**

Option 4 is incorrect: Arete is a narrow ridge of rock that separates two adjacent glacial valleys. It's formed by the erosive action of glaciers on both sides, which carve away the rock, leaving a sharp, often knife-edge ridge. This process is part of glacial erosion and creates distinctive landforms in glaciated mountain regions.

Option 5 is incorrect: **Hanging valleys** are **erosional glacial landform.** They are formed when tributary glaciers, which are smaller than the main glacier, join the main glacier at higher elevations. As the main glacier erodes its valley deeper than the tributary glacier, the mouth of the tributary valley hangs above the floor of the main valley, creating a waterfall or steep drop.

Important Tips

LANDFORMS OF GLACIATION;

Glaciation leads to erosional features in highlands and depositional features in lowlands, though glaciers simultaneously erode, transport, and deposit. Erosion occurs through plucking, where the glacier freezes and tears out blocks from underlying rocks, and abrasion, which scratches and scours the valley floor with debris. These processes create striations and smooth rock surfaces. Factors affecting erosion rate include flow velocity, slope gradient, glacier weight, ice temperature, and valley geology.

Examples of **erosional glacial landforms** includes- **Cirque, Cols, Arete, Horn, Hanging valley, Fjord, Bergschrund, Crag and tail, Nunatak, Ribbon lakes**

158. Solution: (c)

Exp) Option c is the correct answer.

Karst topography is a type of landscape formed by the dissolution of soluble rocks, such as limestone, dolomite, and gypsum. It is characterized by sinkholes, caves, and other landforms created by the erosion of these rocks by water.

Statement 1 is correct: Karst regions often contain lead deposits, making them important sources of this metal. The lead occurs in veins in association with limestone. Example of this includes Yucatan peninsula and Chiapas in Mexico.

Statement 2 is correct: Karst aquifers can be used to store and generate geothermal energy, a renewable source of energy. Geothermal energy is a renewable energy source that comes from heat generated deep within the Earth's core. Karst aquifers are permeable and can store and transmit large amounts of water. They are made of chemically soluble rocks with large passages or a network of conduits and caves inside.

Statement 3 is correct: Karst regions often contain limestone, which is often used as a building material and is a **key raw material for the cement industry.**

159. Solution: (c)

Exp) Option c is the correct answer.

Tectonic lakes are the tectonic depressions formed by the **internal forces of the Earth's crustal movements,** including crustal depressions and subsidence.

Option 1 is correct: Wular lake was formed because of tectonic activity and is fed by the Jhelum River. Wular Lake is the 2nd largest fresh-water lake of Asia (first being Lake Baikal in Russia), situated on the foothills of Harmukh Mountain. However, it faces environmental threats including the conversion of large parts of the lake's catchment areas into agriculture land, pollution from fertilizers and animal wastes, hunting of waterfowl and migratory birds etc.

Option 2 is correct: The majority of Andean lakes owe their existence to either tectonic movements, volcanic eruptions, or the erosive force of glaciers. **Lake Titicaca stands out as a prime example of an Andean Lake shaped primarily by tectonic forces.** It is the largest freshwater lake in South America and the world's highest lake. Lake Titicaca sits 3,810 m above sea level and is situated between **Peru to the west and Bolivia to the east.**

Option 3 is correct: The Caspian Sea, akin to other bodies of water such as the Black Sea, the Aral Sea, were once part of **the ancient Paratethys Sea**. Around 5.5 million years ago, **tectonic forces led to an uplift in the region** coupled with a decline in sea levels, **effectively isolating the Caspian Sea** from the open ocean. This means that tectonic activity in the region led to the formation and evolution of **the Caspian Sea** as we know today.

Option 4 is incorrect: The distinctive star shaped Kodaikanal or Kodai Lake is a product of human engineering rather than natural tectonic processes. It was meticulously constructed in **1863 under the supervision of Sir Vere Henry Levinge**, who served as the Collector of Madurai at the time. Serving as the focal point of Kodaikanal, this man-made lake boasts a depth of 3 meters and spans an area of 60 acres, with a perimeter stretching 4.5 kilometers. Within the lake's catchment area, one can find the **Kurinji (Strobilanthes cynthiana), a unique flowering plant known to bloom once every 12 years.**

160. Solution: (d)

Exp) Option d is the correct answer.

Coastal landforms result from the dynamic interplay of land, sea, and geological forces. Along coastlines, a variety of landforms emerge, each with its distinct characteristics. Following are some of these coastal formations.

Option a is incorrect: Cliffs typically develop as a result of the weathering and erosion of rocks. Generally any very steep rock face adjoining the coast forms a cliff. In coastal areas, strong winds and powerful waves break off soft or grainy rocks from hardier rocks. The harder rocks are left as cliffs. Thus, **cliffs are a high area of rock that forms at the headland (narrow piece of land that sticks out into the sea).**

Option b is incorrect: Barrier islands is a long, narrow strip of sandy beach that lies roughly at the same level as the sea, and it is often covered with plants. It's separated from the main shore by a small lagoon or marsh that's at about the same level as the sea. Beyond that, there's the mainland, which can rise quite steeply, reaching between 10 and 50 feet in height.

Option c is incorrect: Lagoon is an elongated body of water separated from a larger body of water by a shallow coral reef, sandbars or barrier islands. Lagoons are often referred to as estuaries, sounds, bays, or lakes. Those sheltered by sandbars or barrier islands are specifically called coastal lagoons.

Option d is correct: Tombolos are slender sandbars or spits linking an island to the mainland or to another island. They form through the accumulation of sediment carried by waves and currents. Visually, a tombolo resembles a miniature island connected to the coastline by narrow sandy structure or **isthmus.**

161. Solution: (a)

Exp) Option a is the correct answer.

Continental islands are land masses that were once connected to a continental landmass but have become separated due to geological processes such as subsidence, or rising sea levels. Oceanic islands, on the other hand, are land masses that originate from volcanic activity on the ocean floor.

Statement-I is correct: Festoons or island arcs are a chain of volcanic islands that emerge above sea level, forming an archipelago in the shape of a loop around the edge of the mainland. They mark the **continuation of mountain ranges**

that can be traced on the continent, such as the East Indies, the Aleutian Islands, Ryukyu Islands, Kurile Islands, and other island arcs along the Pacific coasts.

Statement-II is correct and explains the Statement-I: Festoon are usually observed at Convergent plate boundaries between two Oceanic plates with different densities. In this situation, the **denser oceanic plate subducts beneath the lighter plate**, resulting in the ocean crust along with its sediments being thrust beneath. Consequently, the **molten magma rises up and forms a pile of volcanic rocks.** The continuous piling of volcanic rocks raises them above the ocean floor and finally exposes them above the sea level **to form Festoons or Island** arcs. Hence statement II is correct and explains the statement-I.

162. Solution: (a)

Exp) Option a is the correct answer.

A glacier is a persistent body of dense ice that is constantly moving under its own weight. From the central dome of the ice cap, ice gradually flows outward in all directions as glaciers. Despite not being a liquid, the glacier moves due to the constant pressure exerted by the accumulated snow above it.

Statement-I is correct: As a **glacier advances, it applies varying pressure on objects** trapped within it. The **central portion of the glacier encounters greater pressure and thus moves more swiftly than its edges, which experience greater friction with the underlying terrain.** This discrepancy in movement leads to the distortion of a straight line of poles, causing them to curve and deform over time.

Statement-II is correct and explains the Statement-I: The sides of a glacier experience greater friction force, slowing down their movement compared to the centre. This difference in movement speed results in poles situated at the sides advancing more slowly than those positioned at the centre, ultimately leading to the formation of a curved structure.

163. Solution: (c)

Exp) Option c is the correct answer.

The geomorphological process of **'river capture'** is also known as **river piracy or river beheading.** River capture occurs **when the flow of one river is diverted to another river or drainage system**, typically due to **erosional processes, tectonic activity, or changes in the landscape.** It involves the reorganization of river networks and drainage patterns. This typically occurs when one river's headwaters erode through a watershed divide and flow into another's drainage basin. As a result, the diverted river effectively "captures" the flow of the original river, altering its course and drainage pattern.

164. Solution: (d)

Exp) Option d is the correct answer.

A river cliff, also known as a cut bank or river-cut cliff, is the **outside bank of a curve or meander in a water channel,** which is continually undergoing erosion. The force of the water erodes and undercuts the riverbank on the outside of the bend where water flow has most energy due to decreased friction. This will form a river cliff.

1) River cliffs are found along meandering and mature streams.
2) River cliffs are almost vertical and tend to expose the root systems of plants and trees found along the streams.
3) River cliffs are constantly undergoing erosion and sometimes cause trees and buildings to topple into the stream

165. Solution: (d)

Exp) Option d is the correct answer.

Ribbon lakes are **long and narrow lakes that are formed by glacial erosion.** They are usually found in glacial valleys, where a glacier moves over an area with alternating bands of hard and soft rock. The **glacier erodes the soft rock more quickly, creating a depression** called a rock basin. The hard rock remains higher and acts as a natural dam. When the glacier melts, the rock basin fills with water and forms a ribbon lake.

Some examples of ribbon lakes are Windermere in England, Driedmeat Lake in Canada, and Lake Washington in the US.

166. Solution: (c)

Exp) Option c is the correct answer.

Solution is a type of chemical weathering process where minerals in rocks dissolve in water, leading to their gradual breakdown and erosion. This process is especially effective on rocks containing minerals that are soluble in water, such as limestone and dolomite.

Statement 1 is correct: Solution chemical weathering process plays a key role in the formation of karst topography by gradually dissolving soluble minerals, typically carbonate rocks like limestone and dolomite, in water. As water infiltrates fractures and pores within these rocks, it chemically reacts with minerals, leading to their dissolution and the creation of various features characteristic of karst landscapes, including caves, sinkholes, disappearing streams, and underground drainage systems. Over time, the continuous dissolution and erosion of soluble minerals by solution weathering shape the unique and intricate surface and subsurface features of karst terrains.

Statement 2 is correct: Among all the types of rocks, **the sedimentary rocks, particularly carbonate rocks like limestone and dolomite, are the most vulnerable to solution weathering.** This is because they often contain minerals such as calcite and dolomite that are highly soluble in water. The rate at which solution takes place is affected not only by the mineral composition of the rock, but also by its structure. Sedimentary rocks often have pore spaces between the grains in which air and water can lodge and thus attack the rock.

Statement 3 is correct: Warm and wet climates typically promote solution chemical weathering. In these conditions, there is more moisture available for chemical reactions to occur, and higher temperatures can accelerate the rates of

these reactions. Additionally, increased rainfall and humidity provide more water for the dissolution process.

On the other hand, **Dry climates provide good conditions for physical or mechanical weathering.**

Important Tips

Chemical weathering refers to the breakdown and alteration of rocks and minerals through chemical processes. There are **several types of chemical weathering**:

1. **Hydration:** This process involves the addition of water molecules to minerals, causing them to expand and weaken. An example is the hydration of anhydrite to form gypsum.
2. **Oxidation and Reduction: Oxidation** involves the reaction of minerals with oxygen, resulting in the formation of new compounds and often a change in color. A common example is the rusting of iron-bearing minerals, such as hematite or limonite. When oxidised minerals are placed in an environment where oxygen is absent, **reduction** takes place. Such conditions exist usually below the water table, in areas of stagnant water and waterlogged ground.
3. **Carbonation**: Carbonation occurs when minerals react with carbon dioxide dissolved in water, forming carbonic acid. This acid then reacts with minerals like calcite or dolomite, leading to their dissolution and the formation of caves, sinkholes, and other karst features.
4. **Decomposition by organic acids:** Bacteria's present in the soil produce acids which, when dissolved in the water, help to speed up the weathering of the underlying rocks.

These types of chemical weathering can occur individually or in combination, depending on factors such as the mineral composition of the rock, the availability of water and acids, temperature, and climate.

167. Solution: (a)

Exp) option a is the correct answer.

Mass movements, also known as mass wasting, refer to the downslope movement of Earth materials under the influence of gravity. Various types of mass movements occur based on factors like the type of material involved, the velocity of movement, and the environmental conditions.

Solifluction, is a type of **mass movement** and **involves the gradual movement of water-saturated soil and rock fragments down a slope.** It typically occurs in temperate areas on frozen subsoil or during freeze-thaw cycles. The term originates from the Latin words "solum" and "fluction," meaning "soil" and "to flow," respectively. Active solifluction can be triggered by various factors, including repeated freeze-thaw cycles, gravitational forces, debris flow, landslides, ice crystal formation, wet soils and regolith after heavy precipitation or snowmelt, volcanic eruptions, exposed soil due to deforestation, and earthquake activity.

Important Tips

Various types of mass movements include:

1. **Landslides:** Landslides involve the rapid movement of a mass of rock, debris, or earth down a slope. They can be triggered by factors such as heavy rainfall, earthquakes, volcanic activity, or human activities like construction.
2. **Rockfalls**: Rockfalls are sudden and rapid descents of individual rock fragments or blocks from a steep rock face. They often occur due to weathering and erosion weakening the rock face or seismic activity.
3. **Debris Flows**: Debris flows, also known as mudflows or lahars (if volcanic), are rapid downhill movements of water-saturated debris, including soil, rock, and vegetation. They typically occur in steep, mountainous terrain and are triggered by heavy rainfall, snowmelt, or volcanic activity.
4. **Creep:** Creep is the slow, gradual movement of soil or rock downhill due to the force of gravity. It often occurs in any climate and involves dry or partially saturated soil or rock.
5. **Slumps**: Slumps are rotational slides in which a mass of material moves along a curved slip surface. They often occur in cohesive materials like clay or silt and are triggered by factors like saturation, undercutting, or seismic activity.

168. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: A **Mesa is a flat-topped landform with steep sides**, commonly found in arid regions due to erosion on sedimentary rock layers by water and winds. **Mesas typically consist of horizontal layers of sedimentary rock,** such as sandstone, shale, and limestone. Erosion by water and wind, removes softer and less-resistant rock layers more quickly than harder layers. As a result, the **harder rock layers form the cap of the mesa**, while the softer rock layers are eroded away to create steep sides. This differential erosion creates the **steep slopes and broad, flat summits, a characteristic feature of mesa.**

Mesas often accompany buttes and canyons and examples include the Grand Mesa in Colorado and Horseshoe Mesa in the Grand Canyon.

Important Tips

Inselberg are isolated residual hills rising abruptly from the level ground. They are characterized by their **very steep slopes and rounded tops.** They are often composed of granite and are probably the relics of an original plateau which has been almost entirely eroded away.

Fjords are deep, narrow coastal valleys formed by glacial erosion and subsequently flooded by seawater. It is found in regions with high mountains and past glaciation. A fjord is formed when a glacier retreats, after carving its typical U-shaped valley, and the sea fills the resulting valley floor.

Eskers are long, winding ridge or mound of sediment consisting of sand and gravel, formed usually as a result of **deposition activity of melted river flown from glaciers**. Eskers are associated with glaciated lowlands. Eskers are commonly found in regions that were covered by glaciers during past ice ages. They are often seen in areas with glacial deposits, such as drumlins, outwash plains, and kettles.

169. Solution: (c)

Exp) option c is the correct answer.

Mount Blanc, located in **Alps**, is the **highest peak of Western Europe**. It lies along the French-Italian border and reaches into Switzerland. It is alco called **"The roof of Europe"**.

Statement 1 is correct: Western Europe's highest peak, Mont Blanc, has shrunk by a significant 2. 22 meters in just two years, according to recent measurements. This dramatic change, confirmed by scientists studying the mountain, brings its current height to 4,805.59 meters.

Statement 2 is correct: Alps and the regions surrounding it is experiencing reduced summer precipitation in recent years, which is most likely contributed due to climate change.

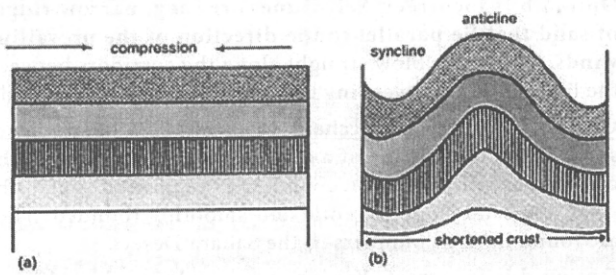
According to various **experts this reduction of the summer rainfall in the Alps, might be a key factor contributing to the shrinkage in the Height of the Mount Blanc.**

As the decreased precipitation, especially snowfall, over several years can directly impact the accumulation of snow and ice on a mountain peak. Less snowfall contributes to less glacier formation and reduces overall ice mass.

170. Solution: (c)

Exp) Option c is the correct answer.

Fold mountains are the most widespread and important type of mountains. They form when **large-scale movements in the Earth's crust create stresses.** These stresses can result from various factors like increased **pressure from overlying rocks, movements in the mantle, intrusion of magma into the crust**. When these stresses occur, rocks undergo compressive forces that cause them to fold or wrinkle along weak lines.



Statement 1 is correct: Fold mountains are closely linked to volcanic activity. They often have active volcanoes, especially in regions like the Circum-Pacific fold mountain system. During the collision of tectonic plates, a phenomenon known as subduction occurs, wherein one plate is pushed beneath another. The zone of subduction causes melting of oceanic crust which generates magma that rises to the surface and forms volcanoes.

Statement 2 is correct: Fold mountains contain rich mineral resources such as **tin, copper, gold and petroleum.** They primarily consist of sedimentary rock and metamorphic rock formed under high pressure and relatively low temperatures. Additionally, an underlying layer of ductile minerals, such as salt, can be present. These minerals contribute to the mineral richness of fold mountains.

Statement 3 is correct: The Himalayas, Rockies, Andes, and Alps are the classic examples of major fold mountains. In these mountains, the folds take on complex forms due to the intricate compressional forces involved.

171. Solution: (c)

Exp) Option c is the correct answer.

Ox-bow lakes are U-shaped water bodies formed when a meandering river cuts off a loop, leaving it isolated from the main channel. These lakes typically develop as Ox-bow lakes when the river changes its course and cuts through the narrow neck of the meander.

Statement 1 is correct: Ox-bow lakes are primarily formed in the mature stage of a river due to the continuous lateral erosion of meanders, which eventually get cut off from the main channel.

Statement 2 is correct: Kanwar Lake in Bihar is India's **largest freshwater ox-bow lake**, formed by the meandering of the Gandak River.

172. Solution: (c)

Exp) Option c is the correct answer.

A desert landform is a place that gets little to no rain. The climate can be either hot or cold and sometimes both.

Option a is incorrect. In several large areas of the world, the surface is covered by deposits of wind-transported silt that has settled out from dust storms over many thousands of years. This material is known as loess. Loess tends to break away along vertical cliffs whenever it is exposed by the cutting of a stream or grading of a roadway. It is also very easily eroded by running water and is subject to rapid gullying when the vegetation cover that protects it is broken.

Option b is incorrect. Seif Dunes are long, narrow ridges of sand that lie parallel to the direction of the prevailing winds. The winds blow straight along the corridors between the lines of dunes, sweeping the corridors clear of the sand.

Option c is correct. Barchans is an isolated heap of free sand. It has the outline of a crescent, and the points of the crescent are directed downwind. On the upwind side of the crest, the sand slope is gentle and smoothly rounded. They are found in large numbers in the Sahara Desert.

Option d is incorrect. Yardangs are sculptured landforms extending up to tens of meters high and kilometers long. They are streamlined hills, carved from bedrock or any consolidated or semi consolidated material by double action of wind abrasion, and deflation. When viewed from above, yardangs resemble the hull of a boat exhibiting commonly asymmetrical shape and elongated leeward tails.

173. Solution: (a)

Exp) Option a is the correct answer.

River capture, also known as river piracy or river beheading, occurs when a river with a steeper gradient or higher precipitation erodes backward (headward erosion) into a divide, eventually diverting the flow of a weaker river into its own channel. This process leads to the expansion of the dominant river's basin at the expense of the weaker one.

The point where this diversion takes place is called the elbow of capture, while the original, now disconnected stream is termed a misfit stream. **The abandoned valley left behind is known as a wind gap, which often serves as a natural route for roads and railways.**

174. Solution: (d)

Exp) Option d is the correct answer.

The **Dalmatian coast** is a type of **submergent and longitudinal coastline** where **mountain ranges run parallel to the coastline.**

A Dalmatian Coast

- It is **named after Dalmatia**, a **coast along the Adriatic Sea in Yugoslavia**.
- The coastline was formed when rising sea levels submerged the coastline, leaving behind long, narrow inlets with a chain of islands parallel to the coast.
- The coastline has **deep and sheltered harbours,** making navigation possible.
- However, the rugged terrain limits inland communication, which **prevents the development of distinguished ports.**
- Apart from the Adriatic Sea, this type of coastline is also found on the **Pacific coasts of North and South America.**
- However, unlike the Adriatic region, the Pacific coastline is more regular and has important ports like San Francisco.

Important Tips

Ria Coast:

1. A submergent coastline formed due to the rise in sea levels after the Ice Age, which drowned river valleys running transversely (at right angles) to the coastline.
2. Unlike the Dalmatian coast, which has parallel mountain ranges, ria coasts have branching inlets separated by headlands.
3. They are common along the Atlantic coasts of northwest France, northwest Spain, southwest Ireland, and parts of the UK (Devon and Cornwall).
4. While they offer deep water and sheltered anchorage, they support few large commercial ports, with smaller fishing ports and naval bases like Plymouth (UK) and Brest (France) being more common.

Fiord Coast:

1. Formed by the submergence of U-shaped glacial valleys carved by glaciers that once flowed down from highlands.
2. Fiords have steep cliffs rising directly from the sea and are extremely deep, often extending far inland.
3. Unlike the Dalmatian coast, which is formed by submerged mountain ridges, fiords are the result of glacial erosion and are found in high-latitude regions such as Norway, Alaska, British Columbia, southern Chile, and New Zealand.
4. Despite their deep, sheltered waters, fiords have few major ports due to their mountainous terrain and poor inland accessibility.

Estuarine Coast:

1. Formed by the submergence of river mouths, leading to the development of funnel-shaped estuaries.
2. Unlike the Dalmatian coast, which has parallel islands and inlets, estuarine coasts are characterized by wide river mouths that facilitate inland navigation.
3. These estuaries provide excellent sites for major ports, such as London (Thames Estuary), Hamburg (Elbe Estuary), and Buenos Aires (Plate Estuary).

175. Solution: (b)

Exp) Option b is the correct answer.

The drainage system refers to the pattern of surface water flow, primarily through rivers. A drainage basin is the area drained by a river and its tributaries. The formation of a drainage system is influenced by various factors, including land slope, geological structure, water volume, and flow velocity.

Option a is incorrect: Dendritic Drainage Pattern resembles the branches of a tree, where smaller tributaries join the main river irregularly, without any specific angle. It is the most common drainage pattern and develops in regions with uniform rock structure such as the rivers of the Northern Plains (Ganga, Yamuna, etc.).

Option b is correct: When the primary tributaries of rivers flow parallel to each other and secondary tributaries join them at right angles, the pattern is known as 'trellis'.

The trellis drainage pattern develops in regions with alternating layers of hard and soft rock, where primary tributaries run parallel and secondary tributaries join them at right angles.

Option c is incorrect: A radial drainage pattern occurs when rivers originate from a central elevated point, like a hill or dome, and flow outward in all directions, seen in the Amarkantak Range, where rivers like Narmada, Son, and Mahanadi originate.

Option d is incorrect: Centripetal drainage pattern forms when rivers **flow inward from multiple directions and converge** into a central depression or lake, a characteristic feature of Loktak Lake in Manipur.

176. Solution: (b)

Exp) Option b is the correct answer.

Option 1 is correct: Cirques are the most common of landforms in glaciated mountains. The cirques quite often are found at the heads of glacial valleys, thus are associated with erosional features.

Option 2 is correct: Horns form through head ward erosion of the cirque walls. If three or more radiating glaciers cut headward until their cirques meet, high, sharp pointed and steep sided peaks called horns form.

Option 3 is correct: Glaciated valleys are trough-like and U-shaped with broad floors and relatively smooth, and steep sides. They are associated with erosional activity of glaciers.

Option 4 is incorrect: The plains at the foot of the glacial mountains or beyond the limits of continental ice sheets are covered with **glacio-fluvial deposits** in the form of broad flat alluvial fans which may join to form outwash plains of gravel, silt, sand and clay. These are depositional landforms.

Option 5 is incorrect: The **drumlins** form due to dumping of rock debris beneath heavily loaded ice through fissures in the glacier. They are associated with depositional activity of glaciers.

177. Solution: (a)

Exp) Option a is the correct answer.

The **continental shelf** is characterized by a **gentle slope and shallow waters** before dropping off at the continental slope. The width of a continental shelf varies significantly across different regions, influenced by factors such as **tectonic activity, sediment deposition, and the geological structure of the coastline.**

Statement-I correct: The continental shelf is the seaward extension of the continent, extending from the shoreline to the continental edge, which is generally marked by the 100-fathom (600 feet) isobath. The **shelves are almost absent or very narrow along some of the margins like the coasts of Chile**, the west coast of Sumatra, etc.

Statement-II is correct: In places where the coast is extremely mountainous such as rocky mountains, Andean coasts, the continental shelves may be entirely absent.

Statement II is the correct reason for Statement I: The Andes mountain chain runs very close and parallel to the western coast of South America because of which the continental shelf is almost absent along the coast of Chile.

178. Solution: (c)

Exp) Option c is the correct answer.

Hamada, Erg, and Reg are three distinct types of desert landscapes, primarily found in arid and semi-arid regions, shaped by **wind erosion, sediment deposition, and weathering processes.**

- **Hamada (Rocky Desert):** A Hamada is a type of desert characterized by hard, barren, rocky plateaus with little to no sand cover. It forms due to wind erosion that removes finer sand particles, leaving behind exposed bedrock or compacted gravel. Ex. **Hamada du Draa** in the Sahara Desert.
- **Erg (Sandy Desert):** An Erg is a vast area covered with thick sand dunes formed by wind deposition. These deserts have shifting sand dunes, some of which can be hundreds of meters high. Ergs are commonly found in regions with a high supply of sand and consistent wind patterns. The Grand Erg Oriental and Grand Erg Occidental in the Sahara Desert are examples of it.
- **Reg (Stony Desert or Gravel Plain):** A Reg is a desert surface covered with pebbles and gravel, with little to no sand. It forms when wind erosion removes finer particles, leaving behind a layer of coarse materials such as stones and pebbles. Regs are often highly compacted and polished due to constant exposure to wind-blown sand. Reg de Tanezrouft in Algeria is an example of it.

179. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: Stalactites and stalagmites are **depositional landforms** commonly found in limestone caves. They are formed due to the **precipitation of calcium carbonate ($CaCO_3$)** from mineral-rich water that drips from cave ceilings.

Formation Process:

1. Limestone, primarily composed of calcium carbonate, dissolves in carbonated water (rainwater mixed with carbon dioxide).
2. When the water carrying dissolved calcium carbonate **evaporates or loses carbon dioxide**, it leads to mineral deposition, forming features such as **stalactites and stalagmites** over time.

Statement 2 is incorrect: Stalactites hang from the ceiling of caves like icicles. They are usually broad at their base and taper towards the free end. They form as mineral-rich water drips from above, leaving behind layers of calcite.

Stalagmites, on the other hand, **rise from the floor of the cave**, forming generally due to dripping water from stalactites above. They may appear as columns, discs, with either a smooth, rounded bulging end or a miniature crater like depression.

Over time, stalactites and stalagmites may fuse to **form pillars or columns.**

Important Tips

Examples of Limestone Caves with Such Features:

1. Batu Caves, Kuala Lumpur

2. Mammoth Caves, Kentucky, USA
3. Carlsbad Cave, New Mexico, USA
4. Postojna Caves, Yugoslavia

180. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: Festoons are curved or loop-shaped chains of islands that typically form along the edges of continents or around the margins of ocean basins.

These island chains often follow a distinct arch-like pattern and can be seen as the continuation of mountain ranges found on nearby continental landmasses.

Formation Process:

- Festoons are **formed at convergent plate boundaries**, along destructive plate margins.
- Here, two tectonic plates converge, and usually, the denser oceanic plate subducts beneath a lighter plate (which may be either continental or oceanic).
- This subduction creates intense compression and folding, resulting in the formation of fold mountains along with volcanic intrusions.
- The volcanic and seismic activity associated with subduction leads to the emergence of these island chains in the form of **festoons or island arcs.**

Examples of Island Festoons: **Kurile Islands, Japanese Archipelago, Philippines and Indonesian Islands.**

Option b is incorrect: A steep-sided canyon formed by river erosion is not a festoon. Instead, it is known as a **gorge or canyon**.

- These landforms develop over millions of years as rivers cut through rock layers, creating deep and narrow valleys.
- **Example:** Grand Canyon (USA) – formed by the Colorado River cutting through layers of rock.

Option c is incorrect: A ring-shaped coral reef island enclosing a shallow lagoon is an **atoll, not a festoon.**

- Atolls are formed when a volcanic island sinks due to subsidence, leaving behind a circular coral reef structure that encloses a shallow lagoon.Atolls grow due to coral reef development in warm, tropical ocean waters over thousands of years.
- **Example:** Maldives Atolls and Bikini Atoll (Marshall Islands).

Option d is incorrect: A crescent-shaped sand dune formed by unidirectional wind in arid regions is called a **barchan dune, not a festoon.**

- Barchan dunes form in deserts where strong winds blow in a single direction, shaping dunes into a crescent (horseshoe) shape.
- The gentle slope of the dune faces the wind, while the steep slip-face is on the opposite side.
- **Example**: Sahara Desert, Gobi Desert.

181. Solution: (b)

Exp) Option b is the correct answer.

Geos and Gloups (blow-holes) are formed due to the continuous action of coastal waves on weak points in cliffs and sea caves. When waves repeatedly strike the roof of a sea cave, air is compressed and released within the rock joints, gradually enlarging the openings. Over time, this process creates a vertical shaft that may pierce through the surface, forming a **Gloup or blow-hole**, through which water or air is forcefully ejected during high-energy wave action. If the erosion continues and the cave roof collapses, it leaves behind a **long, narrow coastal inlet known as a Geo.**

182. Solution: (d)

Exp) Option d is the correct answer.

A wadi refers to a **dry riverbed that contains water only during rainy seasons and is located in a valley-like area of the desert.** It is a type of freshwater ecosystem and fluvial landform associated with rivers or streams. The term, derived from Arabic and Hebrew, refers to a dry riverbed that temporarily holds water during the rainy season. Typically found in desert valleys, wadis are significant geological features shaped by seasonal water flow.

The bottoms of wadis are often covered in sand and loose gravel.The lower levels of this sediment are often packed very densely.This means that during the rainy season, water is not quickly absorbed by the ground and has nowhere to drain, resulting in rapid flooding.

183. Solution: (d)

Exp) Option d is the correct answer.

Option d is correct: A **Bog Burst** is a type of **soil flow (solifluction)** that occurs **when peatland becomes fully saturated with water.**

1. Peat has a high capacity to absorb moisture, but once it reaches its saturation point, the soil structure weakens, causing the waterlogged peat to behave like a liquid.
2. This results in a **sudden downslope movement of peaty soil,** often **resembling a mudflow**.
3. Such events are particularly common in regions with extensive peat deposits, like **Ireland,** where they are specifically referred to as "bog bursts."
4. Bog bursts are often triggered by heavy rainfall or human activities that disturb the delicate equilibrium of peatland ecosystems. Leading to significant landscape changes and damage to infrastructure.

Option a is incorrect: A flood caused by the sudden release of water from a glacial lake

1. This refers to a **Glacial Lake Outburst Flood** (GLOF), not a bog burst. GLOFs occur when a natural dam (formed by ice or moraine) fails, releasing a large volume of water suddenly.
2. Unlike bog bursts, GLOFs involve glacial meltwater, not peat soils, and are associated with high-altitude glacial regions.

Option b is incorrect: A rapid flow of volcanic debris and mud during an eruption

1. This describes a **Lahar**, a dangerous volcanic mudflow that occurs when volcanic ash and debris mix with water (from rain, snowmelt, or crater lakes).
2. Lahars travel at high speeds, resembling rivers of wet concrete, and occur in volcanic regions, unlike bog bursts, which happen in peatland areas.

Option c is incorrect: A sudden collapse of an underground limestone cavern

1. This refers to **Sinkhole Formation**, a process in **karst topography** where limestone or other soluble rock dissolves due to underground water action, leading to the sudden collapse of the surface and creation of a depression.
2. Unlike bog bursts, which involve soil flow, sinkholes involve subsurface erosion and collapse rather than fluid-like movement of soil.

184. Solution: (a)

Exp) Option a is the correct answer.

Statement I is correct: Mechanical weathering, also known as **physical weathering**, is the process of **breaking down rocks into smaller fragments without altering their chemical composition**.

1. It is the **dominant type of weathering in desert regions** because of the extreme environmental conditions, particularly the lack of moisture.
2. Unlike humid regions, where chemical weathering plays a significant role in rock breakdown, deserts primarily experience mechanical weathering due to temperature fluctuations, wind erosion, and salt crystallization.

Statement II is correct: Diurnal temperature range refers to the difference between daytime and nighttime temperatures.

1. In **deserts**, this **range is extreme**—daytime temperatures can exceed 50°C, while nighttime temperatures can drop to near freezing.
2. This intense temperature variation **causes rocks to expand during the day** (thermal expansion) and **contract at night** (contraction), creating **internal stress.**
3. Over time, this stress leads to the **breakdown and** exfoliation (rock layers peeling off) **of rocks.**

Since this process is a direct cause of mechanical weathering, **Statement-II correctly explains Statement-I.**

Statement-II is correct and explains Statement-I because high diurnal temperature variation directly causes thermal weathering, which is a key form of mechanical weathering.

Hence, **Both Statement-I and Statement-II are correct, and Statement-II explains Statement-I.**

185. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct. An "artesian well" is a water well where water flows under natural pressure without pumping. An artesian well is a type of well in **which water flows naturally to the surface** due to pressure from a confined aquifer. Here, the groundwater flows to the land surface because pressure in the rocks underground forces it to the surface.

Groundwater in aquifers between layers of poorly permeable rock, such as clay or shale, may be confined under pressure. If such a confined aquifer is tapped by a well, water will rise above the top of the aquifer and may even flow from the well onto the land surface. Water confined in this way is said to be under artesian pressure, and the aquifer is called an artesian well.

Important Tips

A kettle lake is a depression formed by the melting of ice blocks in glacial outwash plains. A kettle lake is a landform of glaciated lowlands.

In the outwash plains, the depositional activities of glaciers may sometimes take the form of depressions. These depressions are formed by the melting of ice blocks in glacial plains. When these depressions get filled with glacial melt water, it forms the kettle lake.

Naula is a surface-water harvesting method typical to the hill areas of Uttaranchal. These are small wells or ponds in which water is collected by making a stone wall across a stream or river.

186. Solution: (c)

Exp) Option c is the correct answer.

Canyons are striking geological formations, often formed by the erosive action of rivers over millions of years.

Statement 1 is correct: Canyons have steep slopes and are wider at the top due to erosion processes like weathering and the action of water or wind over time. **A canyon is wider at its top than at its bottom.**

Statement 2 is correct: Valley types (V-shaped valley, Canyon and Gorges) depend upon the type and structure of rocks in which they form. For example, **canyons commonly form in horizontal bedded sedimentary rocks and gorges form in hard rocks.**

Statement 3 is incorrect: The Gandikota Canyon is formed by the **Pennar River** (not by the Sharavati river of Karnataka) in Andhra Pradesh and is often referred to as the Grand Canyon of India. It is a popular tourist attraction for its scenic beauty.

187. Solution: (b)

Exp) Option b is the correct answer.

Landforms shaped by running water are among the most dynamic features of Earth's surface. These landforms are created by processes of erosion, transportation, and deposition, which vary in intensity depending on the gradient and flow velocity of rivers and streams.

Pair 1 is correctly matched: **Monadnocks** are isolated, resistant remnants on a nearly flat surface, typically found on peneplains.

Pair 2 is correctly matched: **Peneplains** are almost flat plain like landforms created by prolonged erosion of highlands by the running water.

Pair 3 is incorrectly matched: Point bars are also known as meander bars. They are found on the convex side (and not the concave side) of meanders of large rivers and are sediments deposited in a linear fashion by flowing waters along the bank. They are almost uniform in profile and in width and contain mixed sizes of sediments."Point bars are sediments deposited in a linear fashion by flowing waters along the river bank and are found on the convex side (not the concave side) of meanders of large rivers." Meander is erosional cum depositional landscape. Erosion at one bank is associated with deposition on the other. At erosional bank, river water depth is more and cliff like feature is created. At this place, the slope is concave. It is also termed as cut bank. On the other bank, deposition is prominently observed. Water depth is low and it is called point bar. At this place, the slope is convex.

188. Solution: (a)

Exp) Option a is the correct answer.

Meanders are a common feature in river systems, forming distinct loop-like curves in the channel. They are shaped by various natural forces and processes over time, which influence how rivers flow and erode their surroundings.

Statement 1 is correct: Meander is not a landform but is only a type of channel pattern. This is because of (i) propensity of water flowing over very gentle gradients to work laterally on the banks; (ii) unconsolidated nature of alluvial deposits making up the banks with many irregularities which can be used by water exerting pressure laterally; (iii) **coriolis force acting on the fluid water deflecting it like it deflects the wind.**

Statement 2 is incorrect: Meander formation is **dependent on deposition and erosion processes.** Deposition occurs on the inside of the curve (concave bank), and erosion happens on the outside (convex bank), gradually shaping the meander.

189. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect: Cirques are the most common of landforms in glaciated mountains. **Cirques are deep, long and wide troughs or basins with very steep concave to vertically dropping high walls** at its head as well as sides. The cirques quite often are found at the heads of glacial valleys. The accumulated ice cuts these cirques while moving down the mountain tops.

Horns are pointed peaks that are bounded on at least three sides by glaciers. They form through a headward erosion of the cirque walls. If three or more radiating glaciers cut headward until their cirques meet, high, sharp-pointed and steep-sided peaks called horns form.

Statement 2 is correct: The **formation of tarn lakes is associated with cirques.** A lake of water can be seen quite often within the cirques after the glacier disappears. Such lakes are called cirque or tarn lakes.

190. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: Moraines are forms of depositional landforms formed by deposits of glacial till, the unassorted coarse and fine debris dropped by the melting glaciers. Thus, moraines are long ridges of deposits of glacial till.

Statement 2 is incorrect: Moraines only form in places that have, or used to have, glaciers. Thus, a moraine can be found in an area where a glacier existed in the past. Glaciers are extremely large, moving rivers of ice. Glaciers shape the landscape in a process called glaciation. A **moraine is the material left behind by a moving glacier.** This material is usually soil and rock. Glaciers transport all sorts of dirt and boulders that build up to form moraines.

Statement 3 is correct: A **Glacial Lake Outburst Flood (GLOF) is a release of meltwater from a moraine- or ice-dam glacial lake due to dam failure.** GLOFs are disaster events caused by the abrupt release and downstream movement of water and sediments from the glacial lakes.

Important Tips

Different Types of Moraines:

1. **Terminal moraines** are long ridges of debris deposited at the end (toe) of the glaciers.
2. **Lateral moraines** form along the sides parallel to the glacial valleys.
3. Many valley glaciers retreating rapidly leave an irregular sheet of till over their valley floors. Such deposits varying greatly in thickness and in surface topography are called **ground moraines.**
4. The moraine in the centre of the glacial valley flanked by lateral moraines is called **medial moraine.** They are imperfectly formed as compared to lateral moraines.

191. Solution: (c)

Exp) Option c is the correct answer.

Option c is correct: Fjords were created by glaciers. A **fjord is a long, deep, narrow body of water that reaches far inland.** Fjords are often set in a U-shaped valley with steep walls of rock on either side. They are usually the deepest farther inland, where the glacial force is the strongest. **Some features of fjords include coral reefs and rocky islands called skerries.** Some of the largest coral reefs are found at the bottom of fjords in Norway.

1. Fjords are **found mainly in Norway, Chile, New Zealand, Canada, Greenland, and the U.S. state of Alaska.**
2. Glaciation carves deep valleys. This is why fjords can be thousands of meters deep.
3. A skerry is a small, rocky island created through glaciation.

Option a is incorrect: Outwash plains are planar landforms containing proglacial stream deposits. The outflow of excessive melt water from fast retreating glaciers carries with it rock debris and fine sediment in excess. The sediment load (both as a bed and suspended) is deposited downstream of the retreating glacier in the plains known as outwash plains.

Option b is incorrect: Drumlins are smooth oval-shaped

ridge-like features composed mainly of glacial till with some masses of gravel and sand. The long axes of drumlins are parallel to the direction of ice movement. They may measure up to 1 km in length and 30 m or so in height. Drumlins **provide an indication of the direction of glacier movement.**

Option d is incorrect: The **sinuous ridge of elongated stratified sediments exhibiting bedding is called esker.** Esker is formed within the tunnels developed at the base of the glacier body called the englacial tunnel.

192. Solution: (b)

Exp) Option b is the correct answer.

Desert landforms are classified into two types: erosional and depositional. In hot deserts, wind and running water are the main agents of change. In arid environments, prevailing winds play a significant role in shaping the landscape, creating various topographies.

Row 1 is correct: Sand dunes is **a depositional landform** in deserts. **Barchans are crescent-shaped dunes** with their points or wings facing away from the wind direction. Its crescent shape topography develops due to the presence of obstacles.

Row 2 is incorrect: Seif dunes are **a depositional landform** consisting of long, narrow chains of dunes formed by sand accumulation in the direction of prevailing winds. Crosswinds increase their height and width, while winds parallel to their axis cause them to extend in length.

Row 3 is correct: Inselbergs are isolated mountains formed by erosional processes in desert landscapes. They result from the erosion of surrounding softer materials, leaving behind a resistant rock formation that stands prominently alone.

193. Solution: (c)

Exp) Option c is the correct answer.

Water is an essential natural resource, and its availability is distributed across various sources on Earth. About 71 percent of the Earth's surface is water-covered, and the oceans hold about 97 percent of all Earth's water. The remaining is held as freshwater in glaciers and icecaps, groundwater sources, lakes, soil moisture, atmosphere, streams and rivers and within life or biosphere. The descending order of the amount of water they hold are as follows:

1. **Ice Caps:** Ice caps and glaciers are the largest reservoirs of freshwater on Earth, holding approximately 68-70% of the planet's freshwater.
2. **Groundwater:** Groundwater accounts for roughly 30% of Earth's freshwater. It is stored beneath the Earth's surface in aquifers and is a vital source for drinking water and irrigation.
3. **Lakes:** Lakes contain about 0.26% of the total freshwater. While their contribution is smaller than ice caps and groundwater, they are a key surface water source for many communities.
4. **Streams and Rivers:** Streams and rivers hold the least amount of water among the given options, about 0.006% of the total freshwater. Despite their small volume, they play a critical role in ecosystems and as a readily accessible water source for human use.

Table 13.1 : Water on the Earth's surface

Reservoir	*Volume (Million Cubic km)*	*Percentage of the Total*
Oceans	1,370	97.25
Ice Caps and Glaciers	29	2.05
Groundwater	9.5	0.68
Lakes	0.125	0.01
Soil Moisture	0.065	0.005
Atmosphere	0.013	0.001
Streams and Rivers	0.0017	0.0001
Biosphere	0.0006	0.00004

194. Solution: (d)

Exp) Option d is the correct answer.

Guyots are **flat-topped seamounts** that provide clear evidence of gradual subsidence through various stages, ultimately becoming **submerged flat-topped mountains.**

These formations are **primarily found in ocean basins,** with an estimated **10,000 or more existing in the Pacific Ocean alone,** highlighting their abundance and significance in understanding oceanic geological processes.

Important Tips

1. **Atoll:** Atolls are low-lying islands found in tropical oceans, consisting of coral reefs that surround a central depression. This depression may be part of a sea (lagoon), or sometimes form enclosing a body of fresh, brackish, or highly saline water.
2. **Submarine Canyons** Submarine canyons are deep underwater valleys, some comparable in size to the Colorado river's Grand Canyon. They are sometimes found cutting across continental shelves and slopes, extending from the mouths of large rivers. The Hudson Canyon is one of the most well-known submarine canyons in the world.
3. **Abyssal Plains** Abyssal plains are gently sloping regions of the ocean basins, known as the flattest and smoothest areas on Earth. Located at depths ranging from 3,000 to 6,000 meters, these plains are covered with fine-grained sediments like clay and silt.

195. Solution: (b)

Exp) Option b is the correct answer.

River rejuvenation is the process of renewing or restoring the natural flow of a river. A river is said to be rejuvenated when its base level is lowered. It means 'being young again'.

Statement 1 is incorrect. Rainfall is not one of the prerequisites for the occurrence of River Rejuvenation. Rejuvenation occurs when the river's speed and erosive power increases resulting in an increase in downward erosion. It may occur **when there is an uplift of land or fall in sea level.**

Statement 2 is correct. River rejuvenation involves **a renewed period of vertical erosion** to achieve a new and lower base level. This steepens the river slope and thus active down-cutting is renewed. It causes the river to erode its bed vertically to achieve equilibrium with the slope of the landscape. This down-cutting may lead to **formation of waterfalls, rapids and incised meanders.**

196. Solution: (b)

Exp) Option b is the correct answer.

Geomorphic agents are capable of erosion and deposition. Thus two sets of landforms are produced by them: erosional and depositional.

Option b is correct. Various types of lakes are formed in glaciated terrain by one or the other way and are collectively called glacier lakes. There are depressions left behind after partially-buried ice blocks melt and many of the depressions are filled with water. Such lakes are then called kettle lakes.

197. Solution: (c)

Exp) Option c is the correct answer.

Coastal landforms are primarily shaped by wave action through erosion and deposition, influenced by factors such as the configuration of the coastline and sea floor and whether nature of the coast advances seaward or landward. High, rocky coasts are typically associated with submerged coasts (retreating landward), while low, smooth, and gently sloping sedimentary coasts are characteristic of emerged coasts (advancing seaward).

Statement I is correct: The Coastal Plains of India are a narrow strip of land located between the edges of the Peninsular plateau and the coastline. The region between the Western Ghats and the Arabian Sea is known as the West Coastal Plain, while the area between the Eastern Ghats and the Bay of Bengal is referred to as the East Coastal Plain. **The western coast is primarily shaped by erosional activity, whereas the eastern coast is predominantly characterized by depositional processes.**

Statement II is incorrect: The western coast of India, a high rocky submerged coast (except Malabar Coast), is marked by steep hillsides dropping sharply into the water, creating a highly irregular coastline where rivers appear to be drowned. **Erosional features dominate this region**, and depositional landforms are largely absent. In contrast, **the eastern coast is a low, flat sedimentary emerging coast**, where rivers extend their courses by forming extensive coastal plains and deltas. The land here slopes gently into the water, **with depositional features being the most prominent**.

Thus, the rocky nature of the western coast makes it prone to erosion, while the sedimentary nature of the eastern coast facilitates deposition.

198. Solution: (c)

Exp) Option c is the correct answer.

The continental shelf is the extended margin of the continent, covered by relatively shallow seas and gulfs. It is the shallowest part of the ocean, with an average slope of 1° or less.

Statement 1 is correct: Continental shelves are rich sources of fish, minerals, including sand and gravel, and a significant portion of the **world's petroleum and natural gas.** Notable examples of offshore drilling on the continental shelf include the **Bombay High** and the recent petroleum discoveries in the **Godavari Basin.**

Statement 2 is correct: Continental shelves are much narrower or absent in some continents, particularly **where fold mountains run parallel or close to the coast** as along the eastern Pacific Ocean.

199. Solution: (b)

Exp) Option b is the correct answer.

Karst topography is a unique landscape formed primarily by the dissolution of soluble bedrock, such as limestone, gypsum, or salt. It is characterized by features like sinkholes, swallows, uvalas, and dolines. These features are the result of erosion and collapse processes that occur over time. The landforms of Karst topography in increasing order as per their size are as follows:

1. **Swallows:** Swallows are the smallest features in karst topography. They are shallow, small depressions or holes on the surface of the rock, often forming as a result of the dissolution process. They typically appear as small round or sub-rounded holes and are usually just a few meters in size. Further, the Dolines are the karst topography features which are larger than swallows and are typically formed when the roof of an underground void collapses. They are funnel-shaped depressions that can vary significantly in size, from a few meters to several dozen meters across.
3. **Sinkholes**: Sinkholes are larger than dolines and swallows and are formed either by solution activity or by the collapse of an underground cavity. Sinkholes can range from small ones just a few meters in diameter to larger ones spanning hectares.
2. **Uvalas:** Uvalas are the largest karst features. They form when multiple sinkholes or dolines merge together due to slumping of material along their edges or collapse of cave roofs. This leads to the creation of long, narrow, or wide valleys, which can stretch for kilometers in some cases.

200. Solution: (c)

Exp) Option c is the correct answer.

Offshore bars are underwater sediment deposits that form parallel to the shoreline in the coastal region. Lagoons are created when waves and currents deposit sediments on both sides of these bars, effectively enclosing a section of seawater between the bar and the coast. This enclosed area, typically filled with saline water, is known as a lagoon. Lagoons are connected to the open sea through a narrow passage. Vembanad lake in west coast and Chilka and Pulicat in east coast are examples of lagoons in India.

Option 1 is correct: Vembanad is a coastal lagoon located in the state of Kerala. It has a single, narrow opening to the sea and is believed to have formed from sediments carried by six perennial rivers that originate from the Western Ghats. These rivers created a narrow sandbar in the sea, further west of the shoreline. The only entrance to this enclosed shallow water body is at Kochi. This lagoon is known as the Vembanad Backwater.

Option 2 is correct: Chilika Lake is located on the east coast of India in the state of Odisha. It is the largest brackish water lagoon in the country and the second largest in the world. It has an estuarine character, formed by the confluence of the Daya River and the Bay of Bengal. Spanning a vast area, it is a significant coastal lagoon that plays an important role in the region's ecology and biodiversity.

Option 3 is correct: Pullicat lake is a coastal lagoon situated on the Coromandel Coast, spanning in the states of Andhra Pradesh and Tamil Nadu, it is the second-largest brackish water lagoon in India. The rivers Swarnamukhi and Kalangi in the north and the Arani and the in the south drain into Pulicat Lake during the monsoon.

Option 4 is incorrect: Periyar Lake is not a lagoon; it is an artificial reservoir created by damming the Periyar River, situated away from the coast.

201. Solution: (b)

Exp) Option b is the correct answer.

Natural levees are an important landform **associated with floodplains**. These are formed during the old stage of a river.

Statement 1 is incorrect: Natural levees are **not found in desert landscapes**. Instead, they are **common features along the banks of large rivers.** Natural levees form during river floods **when water overflows its banks. Gradually, water slows down leading to deposition of coarser sediments along the riverbanks.**

Statement 2 is correct: Natural levees **are depositional landforms**. These are low, linear ridges of coarser deposits along the banks of rivers. **During flood events, the sediments (primarily coarse material) get deposited on the banks of a river** forming these **elevated ridges parallel to the river channel.** The deposition of sediment contributes to the growth of these features. Hence, the given option is correct.

202. Solution: (c)

Exp) Option c is the correct answer.

Statements 1, 2 and 3 are correct: Badland Topography is the result of gully or ravine erosion. Ravines are widespread in Chambal basin. So, it is a characteristic feature of Chambal basin. This topography is a feature of arid and semi-arid regions which are **formed by the erosional activity of wind and water on soft sedimentary rocks and clay rich soils**. There are several rock types found in the Badlands topography. The topography contains sandstones, siltstones, mudstones, clay stones, limestones, volcanic ash, and shale.

Statement 4 is incorrect: Mushroom rocks are not found in this type of topography. They are characteristic features of Desert Erosional Landform.

203. Solution: (b)

Exp) Option b is the correct answer.

Glaciation generally gives rise to erosional feature in the uplands and depositional features on the

lowlands. The lowlands of glaciers formed primarily by the deposition activities of glaciers exhibit distinct features.

Pair 1 is incorrect: Moraine refers to the **residue deposited by a glacier in motion, typically composed of soil and rock.** Similar to how rivers transport a variety of debris and silt that gradually accumulate to create deltas, glaciers carry diverse dirt and boulders that accumulate, shaping and forming moraines.

Pair 2 is correct: Eskers are long, winding **ridge or mound of sediment consisting of sand and gravel,** formed usually as a result of deposition activity of melted river flown from glaciers. Eskers are associated with glaciated lowlands. Eskers are commonly found in regions that were covered by glaciers during past ice ages. They are often seen in areas with glacial deposits, such as drumlins, outwash plains, and kettles.

Pair 3 is correct: Erratics are a distinctive type of glacial landform that consists of a **large, isolated boulder or rock** that is different in composition from the bedrock and other surrounding rocks of the area. Glaciers carry rocks along their path of movement and eventually these **rocks are deposited in the landscape far away from the origin of glaciers**. Erratics are typically associated with glaciated

Lowlands.

204. Solution: (c)

Exp) Option c is the correct answer.

A landslide is defined as the movement of a mass of rock, debris, or earth down a slope. In India, landslides occur very frequently in the Himalayas. Landslides also occur in Western Ghats though not as frequently as in the Himalayas.

Statement 1 is incorrect. Western Ghats are relatively tectonically stable and **are mostly made up of very hard rocks. The Western Ghats are primarily composed of igneous and metamorphic rock formations.**

Landslides occur very frequently in the Himalayas. There are many reasons for this, which are:

- The Himalayas are tectonically active.
- The Himalayas are mostly made up of sedimentary rocks and unconsolidated and semi-consolidated deposits
- The slopes of Himalayan Mountains are very steep.

Statement 2 is correct. Western Ghats are relatively tectonically stable and are mostly made up of very hard

rocks; but, still, debris avalanches and landslides occur here. It is **because many slopes are steeper with almost vertical cliffs and escarpments** in the Western Ghats.

Statement 3 is correct. Another reason behind occurrence of landslides in Western Ghats is the **prominence of Mechanical weathering in this region**. Mechanical weathering **due to temperature changes and ranges** is pronounced here.

Statement 4 is incorrect. Landslides occur in Western Ghats also because **they receive heavy amounts of rainfall over short periods**. The region is more known for heavy rainfall, and while prolonged dry spells might cause some soil degradation, the primary factor leading to landslides is heavy rainfall, not dry weather.

Though soil erosion is one of the important factors for occurrence of landslides in western ghats, the dry weather conditions are not the primary reason for the soil degradation in western ghats. Major causes of soil erosion in western ghats include overgrazing, deforestation, mining and infrastructure development.

205. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect: The intensity of bacterial activity differentiates between the soils of cold and warm climates. Humus accumulates in cold climates as bacterial growth is slow. With undecomposed organic matter because of low bacterial activity, layers of peat develop in subarctic and tundra climates. **In humid tropical and equatorial climates, bacterial growth and action is intense and dead vegetation is rapidly oxidised leaving very low humus content in the soil.**

Statement 2 is correct: Chemical weathering activity is enhanced in regions with higher temperatures (Tropics) and reduces in regions with cooler temperatures (with the exception of carbonation) and stops in regions with freezing conditions. Thus, **tropical soils with higher temperatures show deeper profiles** and in frozen tundra regions soils contain largely mechanically broken materials.

206. Solution: (b)

Exp) Option b is the correct answer.

Karst topography is predominantly formed through **carbonation**, a chemical weathering process that occurs when carbon dioxide (CO_2) in the atmosphere dissolves in rainwater, forming weak **carbonic acid** (H_2CO_3).

- This acid reacts with **calcium carbonate** ($CaCO_3$) found **in limestone or other carbonate rocks.** The reaction dissolves the calcium carbonate, gradually creating landforms associated with karst topography, such as **caves, sinkholes, stalactites and stalagmites.**
- Over time, the dissolution of calcium carbonate deepens and widens cracks in the rock, creating the **distinctive Karst landscape**.
- This process is crucial for the development of Karst formations, making carbonation the primary weathering agent in such regions.

Important Tips

Hydration: Hydration involves the absorption of water into a mineral structure, causing it to expand. While hydration can cause some mineral alterations, it does not primarily contribute to the formation of Karst topography. Karst features are formed mainly through the dissolution of rocks, particularly limestone, which is influenced by carbonation, not hydration.

207. Solution: (a)

Exp) Option a is the correct answer.

Saltation refers to a **specific process of particle transport by wind or water in which particles are lifted and then dropped or bounced along the surface**, often causing further erosion or sediment transport. **In wind-driven processes, saltation occurs when wind lifts particles, such as sand grains, from the ground and carries them in short, erratic hops or bounces.** As these particles are transported, they can collide with other particles, dislodging them and initiating further saltation. Saltation is a primary mechanism for the movement of sand dunes in deserts and coastal areas.

208. Solution: (d)

Exp) Option d is the correct answer.

A region with major limestone deposits is called Karst region. It is characterized by barren, rocky ground, and the absence of surface streams and lakes.

Statement a is incorrect. Travertine are dense **banded calcareous deposits (calcium carbonate, CaCO3)** which occurs in limestone caves in the form of stalactites and stalagmites. It is a variety of limestone that has a light colour and takes a good polish and is often used for walls and interior decorations in public buildings.

Statement b is incorrect. When a number of swallow holes coalesce, a large depression is formed and is called a doline.

Statement c is incorrect. Stalagmites form due to dripping water from the surface or through the thin pipe, of the stalactite, immediately below it. Moisture dripping from the roof trickles down the stalactite and drops to the floor where stalagmites are formed due to deposition of calcium carbonate.

Statement d is correct. Lapies refers to the highly corrugated and rough surface of limestone lithology **characterized by low ridges and pinnacles, narrow clefts and numerous solution holes.** Lapies represent a fretted and fluted topography marked by small rills and gullies, minor ridges or pinnacles and deep clefts. Lapies are variously named in different parts of the world e.g., clints or grykes in North England, karren in Germany, bogazin earstwhile Yugoslavia etc. These are generally formed due to corrosion of limestones along their joints when limestones are well exposed at the ground surface.

209. Solution: (b)

Exp) Option b is the correct answer.

A canyon is a deep, narrow valley with steep sides. The movement of rivers, the processes of weathering and erosion, and tectonic activity create canyons.

Option a is incorrect. Royal Gorge is one of the deepest and narrowest canyons in Colorado. This regal ravine is divided by the Arkansas River and is a hotspot for rock climbing, base-jumping, and bungee-jumping. The Royal Gorge Bridge is actually the highest official jump platform in the world.

Option b is correct. The Grand Canyon is located in the U.S. state of Arizona. It is a product of tectonic uplift. The Grand Canyon is the largest canyon in the United States. It has been carved as the Colorado River cuts through the Colorado Plateau. It lies in the south-western portion of the Colorado Plateau.

The Plateau's arid climate produced many striking erosional forms, culminating in the Grand Canyon. The Canyon's mile-high walls display a largely undisturbed cross section of the Earth's crust extending back some two billion years.

The Pueblo people considered the Grand Canyon a holy site and made pilgrimages to it.

Option c is incorrect. Antelope Canyon is a slot canyon in the America's Arizona. It is divided into two main upper and lower photogenic sections: The Crack and The Corkscrew. This stunning rock formation was formed by erosion of Navajo Sandstone due to flash flooding and erosion caused by airborne sand. The canyon is on Navajo Tribe land and has only been accessible to the public since 1997.

Option d is incorrect. Situated in **Kings Canyon National Park**, this canyon actually features the deepest gorge in the country. The park is rich in unspoiled backcountry hiking, climbing, and scenic lookout points. Spring is one of the most beautiful times to visit this stunning area, as the warmer weather encourages the mountainside to sprout blankets of wildflowers and tender green grass.

210. Solution: (d)

Exp) Option d is the correct answer.

Erosion is the wearing away of the landscape by different agents like water, wind and ice. Different landforms created on the surface of the earth because of erosion are called erosional landforms.

Option a is incorrect. Capes and Bays are erosional features of coastlands. On exposed coasts, the continual action of waves on the rocks of varying resistance causes the coastline to be eroded irregularly. This is particularly pronounced where hard rocks occur in alternative band with softer rocks. **The softer rocks are worn back into inlets or bays & the harder ones persist as headlands or capes.** Even where the coastline consists of one rock type, irregularities will be caused by variation within the rock.

Option b is incorrect. Stack & Stump are erosional features of coastlands. Prolonged waves attack on the base of the cliff & excavate holes in regions of local weakness called cave. When 2 caves approach each other from either side of headland & unite, they form an arch. Further erosion by waves will lead to total collapse of the arch. The seaward portion of the headland will remain as a **pillar of rock known as stack**. With the course of time, these stubborn stacks will gradually be eroded, **leaving behind the stumps,** which are only just visible above the sea level.

Option c is incorrect. Geos & Gloups are erosional features of coastlands. The occasional splashing of the waves against the roof of a cave may enlarge the joints when air is compressed & released repeatedly inside them. A natural shaft is thus formed which may eventually pierce through the surface. Waves breaking into the cave may force water or air out of this hole. Such a shaft is termed as Gloup or blow hole. The enlargement of blow-holes & continual action of waves weakens the cave roof. When the cave roof collapses, a long, narrow creek may develop known as Geos.

Option d is correct. Spits and Bars are the depositional features of wave action.

A spit is an extended stretch of sand or shingle jutting out into the sea from the land. Spits occur when there is a change in the shape of the landscape or there is a river mouth.

Sometimes a spit can grow across a bay, and joins two headlands together. This landform is known as a bar. They can trap shallow lakes behind the bar, these are known as lagoons. Lagoons do not last forever and may be filled up with sediment.

211. Solution: (c)

Exp) Option c is the correct answer.

Fluvial erosion is the detachment of material of the river bed and the sides.

Erosion starts when the flow energy of the water exceeds the resistance of the material of the river bed and banks. Flow energy depends on depth of water and gradient and thus of stream velocity

Statement 1 is correct: Rill erosion occurs when runoff water forms small channels as it concentrates down a slope. These rills can be up to 0.3m deep. If they become any deeper than 0.3m they are referred to as gully erosion. **Gully erosion happens when runoff concentrates and flows strongly enough to detach and move soil particles.**

Statement 2 is correct: The region of weak sedimentary formations is extensively eroded by numerous rills and channels/gullies which are occasionally developed due to occasional rainstorms. The linear fluvial erosion by rills and gullies results in the formation of ravines and gullies which are divided by numerous undulating narrow ridges. **Such a landscape is called badland topography,** For example, Chambal Ravines.

212. Solution: (a)

Exp) Option a is the correct answer.

Statement a is incorrect. A meander (and not a Levee) becomes an oxbow lake along the side of the river.

Levee is an embankment alongside a **river, produced naturally by sedimentation or artificially. Levees can protect against floods.** These features are typically well developed along low-gradient sinuous rivers with large

suspended-sediment loads that are subject to deep overbank floods. **(Statement c is correct)**

- The natural movement of a body of water pushes sediment to the side, creating a natural levee. **The banks of a river are often slightly elevated from the river bed. These banks form levees made** of sediment, silt, and other materials pushed aside by the flowing water. **(Statement b is correct)**
- Levees are usually parallel to the way the river flows, **so levees can help direct the flow of the river. (Statement d is correct)**
- Levees can also be artificially created or reinforced. Artificial levees are usually built by piling soil, sand, or rocks on a cleared, level surface. People have been building and reinforcing levees since the beginning of civilization.

As early as 2500 BCE, the Indus Valley Civilization, with urban centers of Mohenjo Daro and Harappa, people used levees to protect land near the Indus River. Thus, farmers were able to grow crops like cotton and rice.

213. Solution: (b)

Exp) Option b is the correct answer.

1. The **Great Victoria Desert** is a sparsely populated desert ecoregion and interim Australian bioregion in **Western Australia and South Australia**. It is the largest desert in Australia and consists of many small sandhills, grassland plains, areas with a closely packed surface of pebbles (called desert pavement or gibber plains), and salt lakes.
2. The **Grand Canyon** is a steep-sided canyon carved by the Colorado River in Arizona, **United States**. The Grand Canyon is 277 miles (446 km) long, up to 18 miles (29 km) wide and attains a depth of over a mile (6,093 feet or 1,857 meters).
3. **Lake Winnipeg** is a very large, relatively shallow 24,514-square-kilometre (9,465 sq mi) lake in **North America, in the province of Manitoba, Canada**. Its southern end is about 55 kilometres (34 mi) north of the city of Winnipeg. Lake Winnipeg is Canada's sixth-largest freshwater lake and the third-largest freshwater lake contained entirely within Canada. It is the eleventh-largest freshwater lake on Earth. The lake's east side has pristine boreal forests and rivers that were in 2018 inscribed as Pimachiowin Aki, a UNESCO World Heritage Site.
4. The **Southern Alps** are a mountain range extending along much of the length **of New Zealand's South Island**, reaching its greatest elevations near the range's western side. The name "Southern Alps" generally refers to the entire range, although separate names are given to many of the smaller ranges that form part of it.

214. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct - Along high rocky coasts, **waves break with great force against the land shaping the hill sides into cliffs. With constant pounding by waves, the cliffs recede leaving a wave-cut platform in front of the sea cliff.** After a considerable period of cliff development, a wave-built terrace would develop in front of wave-cut terrace.

Statement 2 is correct - The constant erosion of rocky headlands may produce a variety of **particular geomorphic structures, including sea arches and sea stacks.** With prolonged erosion, sea arches may collapse to form sea stacks—steep pillars of rock a short distance from the mainland. Both sea stacks and sea arches are impermanent features that will eventually disappear with continued erosion.

Statement 3 is correct - As the erosion along the coast takes place a good supply material becomes available to longshore currents and waves to deposit them as beaches along the shore and as bars (long ridges of sand and/ or shingle parallel to the coast) in the nearshore zone. **Bars are submerged features and when bars show up above water, they are called barrier bars.**

Statement 4 is correct - Barrier bar which gets keyed up to the headland of a bay is called a spit. When barrier bars and spits form at the mouth of a bay and block it, a lagoon form. The lagoons would gradually get filled up by sediments from the land giving rise to a coastal plain.

215. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. Cirque lakes or tarns are **formed by glaciation (not of volcanic activity)**. A glacier on its way down the valley leaves behind circular hollows in the heads of the valleys up in the mountains. Such hollows are cirques or corries. Their over deepened floor may be filled with water to form cirque lake or tarns.

Statement 2 is correct. Lakes formed due to landslides screes & avalanches are known as barrier lakes. **Such Lakes formed by landslides are short lived** because of loose fragments that pile up across the valleys will soon rupture under pressure & will give way to water. When they suddenly give way, the dammed water rushes down causing floods.

Statement 3 is correct. Lakes are only **temporary features of earth crust;** they will eventually be eliminated by the process of draining and slitting up. Example in hot deserts lakes disappear altogether by combined process of evaporation, percolation and outflow.

216. Solution: (a)

Exp) Option a is the correct answer.

Chemical weathering processes viz; **solution, carbonation, hydration, oxidation and reduction** act on the rocks to decompose, dissolve or reduce them to a fine clastic state through chemical reactions by oxygen, surface and/or soil water and other acids.

Statement 1 is correct. In the process of oxidation, chemical weathering works on **rocks that contain iron.** These **rocks turn to rust** in the process. As rust expands, it weakens rock

and helps break it apart. Oxidation occurs where there is ready access to the atmosphere and oxygenated waters. The minerals most commonly involved in this process are **iron, manganese, sulphur etc.** In the process of oxidation rock breakdown occurs due to the disturbance caused by addition of oxygen.

Statement 2 is incorrect. Hydrolysis (and not hydration) is the form of chemical weathering in which a new solution (a mixture of two or more substances) is formed as chemicals in rock interact with water. For example: In many rocks sodium minerals interact with water to form a saltwater solution.

In contrast, hydration is a form of chemical weathering in which the **chemical bonds of the mineral are changed** as it interacts with water. Minerals take up water and expand; this expansion causes an increase in the volume of the material itself or rock. Calcium sulphate takes in water and turns to gypsum, which is more unstable than calcium sulphate. This process is reversible and long, continued repetition of this process causes fatigue in the rocks and may lead to their disintegration.

217. Solution: (b)

Exp) Option b is the correct answer.

Pair 1 is incorrect. Raindrop splash erosion is a **result of the energy of falling raindrops (and not canal irrigation)** causing **detachment of soil particles** and down-slope movement of sediment. Maintenance of ground cover, such as in reduced- or no-till operations, use of cover crops, and enhancement of the stability of soil aggregates can be important in reducing detachment of soil particles.

Pair 2 is correct. Sheet erosion occurs as a shallow 'sheet' of water flowing over the ground surface, resulting in the removal of a uniform layer of soil from the soil surface. Sheet erosion takes place **on level lands after a heavy shower** and the soil removal is not easily noticeable. But it is harmful since it removes the finer and more fertile top soil.

Pair 3 is correct. Rills are shallow drainage lines less than 30cm deep. They develop when **surface water concentrates in depressions** or low points through paddocks and erodes the soil. It is the process by which numerous small channels–less than three inches in depth–are formed. This type of erosion can be especially serious on recently cultivated land. It can be best minimized by minimizing sheet flow, such as by maintaining crop residues and utilizing cover crops. Physical barriers, such as terraces, and vegetative barriers can be effective in stopping or reducing rill erosion.

Important Tips

Gully erosion refers to the cutting of narrow channels called gullies. The gullies can be caused by small channels of approximately 3 to 12 inches deep. Gully erosion cuts deep and **removes the surface soil as well as deeper soil** that may still have substantial amounts of total nutrients but less compared to the surface soil. It is **common on steep slopes.**

218. Solution: (c)

Exp) Option c is the correct answer.

An aquifer can be defined as a formation containing sufficient saturated permeable material which can yield significant qualities of water to wells and springs.

Statement 1 is correct: Unconsolidated or loosely consolidated sand and gravel deposits form the best aquifers. This deposit consists of strata of coarse material in between silt and clay layers. Alluvial fans form good water bearing deposits when groundwater level is quite high.

Statement 2 is correct: It is observed that **sedimentary materials constitute the largest percentage of earth's aquifers,** including coarse unconsolidated materials and hard sedimentary rocks like, limestone and dolomite.

Statement 3 is incorrect: Clays, which contain large proportion of pores, are not good aquifers. The pores being very small in size therefore water cannot move readily through the clay mass.

GENERAL GEOGRAPHY

OCEANOGRAPHY

3.1. Movement, Relief, Temperature & Salinity of the Oceans

1. Consider the following pairs:

Ocean topography	Features
1. Mid oceanic ridges	Zone of intense volcanic activity
2. Sea mounts	Zone of low biological productivity
3. Submarine canyons	Deep valleys in the continental shelves
4. Guyots	Mountain in ocean with pointed summits

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

2. With reference to the effects of ocean currents on the climate and temperature around the world, consider the following statements:

1. The presence of warm ocean currents along the Peruvian coast results in good monsoonal rainfall in India.
2. The presence of canaries current along the Western coast of Africa leads to the formation of Sahara deserts.
3. The presence of cold Labrador currents along the east coast of America freezes their ports for several months.
4. The presence of warm ocean currents along the eastern coast of South America leads to the formation of pampas grassland.

Which of the statements given above is/are correct?

(a) 2, 3 and 4 only
(b) 1 and 4 only
(c) 2 and 3 only
(d) 1, 3 and 4 only

3. Which of the following statements are correct with respect to variation of the temperature of ocean water across the world?

1. There is a uniform increase in the rate of decrease of temperature with an increasing depth of the ocean.
2. The oceans in the northern hemisphere are hotter than in the southern hemisphere.
3. The enclosed seas in both lower and higher latitudes have higher temperatures than the open seas.
4. The atmospheric air circulation can influence the temperature of the ocean.

Select the correct answer using the code given below:

(a) 1, 2 and 4 only
(b) 2 and 3 only
(c) 2 and 4 only
(d) 1 and 4 only

4. With reference to the Ocean Currents, consider the following statements:

1. Warm Currents are mostly found along the West Coasts of Continents in tropical and subtropical latitudes.
2. Ocean Currents are stronger at the surface than at the deeper depths.
3. The mixing of Warm and Cold Ocean Currents can cause rainfall in the region.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 1 only
(c) 2 and 3 only
(d) 1, 2 and 3

5. With reference to the Thermocline, consider the following statements:

1. It represents the topmost layer of the ocean water in tropical regions.
2. It is characterised by rapid decrease in temperature with increasing depth.
3. The zone of thermocline is non-permanent in temperate regions.
4. Thermocline can be absent in the polar regions.
5. Most of the volume of seawater is usually found below the Zone of Thermocline.

Which of the statements given above are correct?

(a) 1, 3 and 4 only
(b) 2, 3, 4 and 5 only
(c) 3 and 4 only
(d) 2 and 5 only

6. With reference to the life forms in the deep ocean, consider the following:

Assertion: Some Aquatic life forms are found even in the submarine trenches.

Reason: Some Aquatic life forms can rely upon the chemosynthesis for energy.

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is not the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true

7. With reference to the distribution of major ocean currents across the ocean, which of the following are correctly matched?

Major Ocean Currents	Location
1. Humboldt current	Western coast of Africa
2. Labrador current	Eastern coast of Canada.
3. Agulhas current	Eastern coast of Australia.
4. Kuroshio current	Eastern coast of Japan.

Select the correct answer using the code given below:

(a) 1, 2 and 4 only
(b) 2 and 3 only
(c) 2 and 4 only
(d) 1 and 4 only

8. With reference to the Oceanic Waves, consider the following statements:

1. They move across the ocean because of the action of both wind and gravitational force on the water.
2. They can transport water particles to a larger distance.
3. They break when the depth of water is less than half the wavelength of the wave.
4. They lose energy and continue to become smaller in size as they move.

Which of the statements given above are correct?

(a) 1, 2 and 4 only
(b) 1 and 3 only
(c) 2 and 4 only
(d) 3 and 4 only

9. With respect to Oceanic Tides, consider the following statements.

1. Neap tides occur during full moon and new moon days.
2. Spring tides occur when the sun and the moon are at right angles to each other.
3. The spring tides are generally higher than the neap tides.
4. The tidal range is usually higher when the moon is closer to the earth.

Which of the statements given above are correct?

(a) 1 and 4 only
(b) 2 and 3 only
(c) 3 and 4 only
(d) 1 and 2 only

10. Which among the following are the likely reasons for Japan having a well-established fishing industry?

1. Meeting of warm and cold ocean currents near the coast of Japan
2. The presence of the indented coastline along the coasts of Japan.
3. Lack of plankton on continental shelves around the coasts of Japan.

Select the correct code from the options given below:

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

11. Consider the following pairs with reference to different types of Coral reefs:

Types of Coral Reefs	Description
1. Fringing reef	It grows seaward directly from the shore and form borders along the shoreline.
2. Barrier reef	It is separated from the shore by a lagoon.
3. Atoll	It is a circular oceanic reef system surrounding a large central lagoon

Which of the pairs given above is/are correctly marched?

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

12. With reference to Ocean currents, consider the following pairs:

Current	Feature
1. Humboldt current	a main cause of dry climatic conditions prevailing in Atacama Desert
2. Gulf stream	Responsible for bringing warm water from the Gulf of Mexico to the east coast of North America
3. Canaries current	Cold ocean current that flows off the west coast of Africa

How many of the above given pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

13. Consider the following statements:
1. The rate of decrease of temperature of oceans with depths is lower at the equator than at the poles.
2. The winds blowing from the land towards the ocean helps in upwelling of cold water at the coast.
3. The enclosed seas in the high latitudes record relatively higher temperatures than the open seas.

Which of the statements given below is/are correct?
(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 2 and 3 only

14. Which of the following factors affect the movement of ocean current?
1. Latitudinal location of the ocean.
2. Rotation of the earth.
3. Direction of the wind.
4. Variation of salinity across the ocean.
5. Gravitational force of Sun and Moon on the Earth.

Select the correct answer using the code given below:
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 2, 3 and 4 only
(d) 1, 2, 3, 4 and 5

15. With reference to the upwelling and downwelling process of the ocean water, consider the following statements:
1. Upwelling of an ocean occurs when the wind blows towards the shore.
2. Downwelling of an ocean occurs in the divergence zone of ocean water.
3. Upwelling region offers one of the best fishing grounds across the world.
4. Fogs near the coastal area are a likely indicator of an upwelling zone.

Which of the statements given above is/are correct?
(a) 1,2 and 3 only
(b) 1,2 and 4 only
(c) 3 only
(d) 3 and 4 only

16. With reference to the salinity in oceans, which of the following statements is/are correct?
1. Areas near the equator usually have high salinity because of the high rate of evaporation.
2. The mid latitude regions have low salinity because of the large amount of rainfall.
3. Large influx of freshwater into oceans near polar regions results in low salinity.

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

17. With respect to ocean temperatures consider the following statements:
1. The annual range of temperature in oceans is larger than the range of temperature on land.
2. There is a constant reduction of mean annual temperature in oceans as we go from lower to higher latitudes.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

18. Consider the following statements regarding the Ocean Gyres:

1. They are the large systems of circular ocean currents.
2. They are most prominent at the equator, as compared to higher latitudes.
3. All the Ocean Gyres flow in a clockwise direction.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) 1 and 2 only
(d) 1 and 3 only

19. Consider the following statements with reference to the 'Continental Shelves':

1. Continental shelves are characterised by a very steep gradient of slope.
2. Continental shelves can be almost absent along some of the coasts.
3. Continental shelves are a major source of oil deposits around the world.
4. Continental shelves have among the world's richest fishing grounds.

Which of the statements given above are correct?

(a) 2 and 3 only
(b) 2, 3, and 4 only
(c) 3, and 4 only
(d) 1, 2 and 4

20. Which of the following is correct about the Oceanic Trenches?

(a) They are usually formed at the base of Continental Slopes.
(b) They are relatively calm zones free from earthquakes and volcanoes.
(c) The Deepest Ocean trenches are found in the Atlantic Ocean.
(d) Mariana Trench is a result of convergence of two Continental Plates.

21. It is a vast, flat region on the ocean floor situated between continental margins and mid-oceanic ridges. Is it the result of the accumulation of continental sediments that extend beyond the margins.

The above passage refers to which of the following features?

(a) Continental shelf
(b) Seamounts
(c) Continental slope
(d) Abyssal plain

22. Consider the following statements regarding the effects of 'coastal upwelling, in oceans:

1. It helps in curbing the growth of seaweed in the coastal waters.
2. It makes the coastal zones highly suitable for fishing activities.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

23. Consider the following statements regarding an Oceanic Gyre:

1. These are the oceanic currents moving in an anti-clockwise direction in the Northern Hemisphere.
2. The central areas of gyres are the most productive regions of an ocean supporting the growth of diverse marine ecosystems.
3. The Sargasso Sea, formed due to an oceanic gyre, lies in the Pacific Ocean.

How many of the statements given above are correct?

(a) Only one
(b) Only two
(c) All three
(d) None

24. They are a specific type of relief features of seafloor which is formed when an underwater mountain undergoes erosion from the relentless force of powerful ocean waves, resulting in its summit being flattened. They show evidence of gradual subsidence through stages to become flat topped submerged mountains."

Which of the following oceanic structures has been best described in the above paragraph?

(a) Atoll
(b) Mid-oceanic ridge
(c) Guyot
(d) Volcanic Island

25. With reference to the effects of ocean currents on the climate and temperature around the world, consider the following statements:

1. The presence of warm ocean currents along the Peruvian coast leads to high monsoonal rainfall in India.
2. The presence of Canaries current along the western coast of Africa leads to scarce

rainfall conditions in the Sahara Desert region.

3. The mixing of Labrador current (cold current) with Gulf of stream (warm current) causes drizzling in Newfoundland.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

26. With reference to the difference between the Deep-Water Ocean Currents and Surface Water Ocean currents, consider the following statements:

1. Deep water currents are primarily driven by density differences of ocean waters, while surface water currents are mainly driven by the winds.
2. Generally, surface water currents move faster than the deep-water currents.
3. While Surface water currents have significant impact on global climate, deep water currents have negligible impact on global climate.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 only
(d) 2 only

27. With reference to the salinity in oceans, consider the following statements:

1. Areas near the equator have higher salinity compared to tropics because of the high rate of evaporation.
2. The mid latitude regions have the lowest salinity because of the large amount of rainfall.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

28. With reference to Mid-Oceanic Ridges, consider the following statements:

1. They are formed at divergent plate boundaries.
2. These ridges are the longest mountain-chain on the surface of the earth.
3. Hydrothermal vents found along mid-oceanic ridges support unique deep-sea ecosystems.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2, and 3

29. With reference to Ocean Waves, consider the following statements:

1. The primary force responsible for the movement of ocean waves is the frictional force of the wind acting on the water surface.
2. Waves in closed seas are generally larger than those in the open ocean.
3. When the depth of water is less than half the wavelength of the wave, the wave breaks.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2, and 3

30. The Sargasso Sea is unique in the sense that its boundaries are defined only by ocean currents. In this context, which of the following groups of ocean currents forms the boundary of the Sargasso Sea?

(a) Canary Current; North Atlantic Equatorial Current, Agulhas Current and Benguela Current
(b) Gulf Stream; Labrador Current; Canary Current and Agulhas Current
(c) Benguela Current; Gulf Stream, North Atlantic Current and Canary Current
(d) Gulf Stream; Canary Current; North Atlantic Equatorial Current and North Atlantic Current

31. Consider the following statements about ocean trenches:

1. Earthquakes frequently occur in trench regions due to tectonic activity.
2. No lifeform exists in trenches due to high pressure and lack of sunlight.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

32. There is a region which is known for its abundant fish population. Which one of the following is the most appropriate action should a fisherman in a small boat take to maximise his catch, considering the impact of tides on fish movement in that region?

(a) Casting his net during low tide when fishes are concentrated in shallower waters.
(b) Casting his net during high tide when fishes are dispersed over a larger area.
(c) Casting his net shortly after high tide when fishes are feeding actively in shallower areas.
(d) Regardless of tidal levels, casting his net during a period of strong tidal currents as the increased water movement stimulates fish activity.

33. With respect to tides consider the following statements:

Statement-I: The height of the tide in spring tides are higher than the height of tide in neap tides.

Statement-II: While the Spring tides occur during new moon day, the neap tides occur during full moon day.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect, but Statement-II is correct.

34. Consider the following statements regarding the Oceanic Waves:

1. The waves involve the horizontal movement of water in large quantities across the ocean surface.
2. While approaching the seashore, the waves break when the depth of water equals the wavelength of the wave.
3. Their height is determined by the strength of the winds prevailing over the region.

Which of the statements given above is/are correct?

(a) 3 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) None of the above

35. Consider the following statements regarding 'Atolls':

1. An atoll is a ring-shaped coral reef that surrounds a lagoon.
2. Only the hard Corals can aid the formation of an atoll and not the soft corals.
3. These are commonly found in the regions having strong oceanic currents.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2, and 3

36. Consider the following statements with reference to the 'Continental Shelves':

1. They are characterised by a very steep gradient of slope.
2. They make up more than 50 percent of the total area of the oceans.
3. They can be almost absent along some of the coasts.

Which of the statements given above are correct?

(a) 3 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) None of the above

37. Consider the following statements:

Statement-I: The Dead Sea has higher levels of salinity than the average salinity of the world's oceans.

Statement-II: The Dead Sea undergoes a high rate of evaporation and is landlocked between two countries.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

38. Consider the following statements regarding the 'delta' formations:

1. Deltas can only be formed when a river empties into an ocean or a sea.
2. Tidal activities in the oceanic waters favor the formation of deltas.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

39. Consider the following pairs:

Ocean topography	Features
1. Mid oceanic ridges	Zone of intense volcanic activity
2. Sea mounts	Zone of low biological productivity
3. Submarine canyons	Deep valleys in the continental shelves
4. Guyots	Mountain in ocean with pointed summits

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

40. Which of the following situations would most likely result in the formation of a 'Lagoon'?

(a) Sedimentary beds of rivers/streams become gentler due to continued erosion.
(b) A River shifts laterally making a series of natural levees.
(c) Barrier bars and spits are formed at the mouth of a bay, and they block it.
(d) Waters spill over the banks during flooding above the riverbed.

41. Consider the following statements:

Statement I: The highest surface temperatures in the oceans are not recorded precisely at the equator but slightly north of it.

Statement II: The freshwater discharge through rivers is maximum near the equatorial ocean region.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I
(c) Statement-I is correct but Statement-II is incorrect
(d) Statement-I is incorrect but Statement-II is correct

42. Consider the following statements regarding Isthmus and Strait:

1. While Isthmus connects two land surfaces, the Strait connects two water bodies.
2. Isthmus can be formed because of depositional activities of the ocean waves.
3. The strait can be formed because of tectonic activity.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1 and 3 only

43. Which one of the following salts contributes maximum to the salinity of sea water?

(a) Calcium sulphate
(b) Magnesium chloride
(c) Magnesium sulphate
(d) Sodium chloride

44. In the context of distribution of temperature in the oceans, consider the following phenomena:

1. Ocean Currents
2. Insolation
3. Proximity to land
4. Winds

How many of the above factors directly contribute to the distribution of temperature in the oceans?

(a) Only one
(b) Only two
(c) Only three
(d) All four

45. Consider the following statements about the thermocline:

1. It is a boundary region in the ocean where there is a rapid increase of temperature with increasing ocean depth.
2. It normally begins at a depth of 100–400 meters from the ocean surface and extends several hundred meters downward.

3. In Polar regions, the thermocline is often shallow or absent.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) 1 and 3
(d) 2 and 3

46. Consider the following factors:
1. Ocean currents
2. Freezing and thawing of ice
3. Winds
4. Freshwater flow from rivers

How many of the above factors affect the salinity of the oceans?
(a) Only one
(b) Only two
(c) Only three
(d) All four

47. "It is the second-largest lake in the Middle East region. It is known for having one of the highest salinity levels among naturally formed water bodies. With a salinity level of 330 o/oo (330 parts per thousand), it stands out as one of the most saline lakes in the world. The lake is situated in an enclosed basin, with no outlet, contributing to the high concentration of salts."

Which one of the following lakes is being described in the above paragraph?
(a) Great Salt Lake
(b) Lake Rebta
(c) Lake Eyre
(d) Lake Van

48. With reference to Salinity of oceans, consider the following statements:

Statement I: Despite being located in similar latitudes, the North Sea experiences higher salinity levels than the Baltic Sea.

Statement II: Unlike the Baltic Sea, the North Sea is an endorheic sea without any natural outlet to the ocean.

Which one of the following is correct in respect of the above statements?
(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation for Statement I
(b) Both Statement I and Statement II are correct but Statement II is not the correct explanation for Statement I
(c) Statement I is correct, but Statement II is incorrect
(d) Statement I is incorrect, but Statement II is correct

49. In the context of the tide formation, when will the higher spring tides in the ocean occur?
(a) The Moon, Sun, and Earth are in a straight line, with the Moon and Sun on opposite sides of the Earth.
(b) The Moon, Sun, and Earth are in a straight line, with the Moon and Sun on the same side of the Earth
(c) The Moon and Sun are at right angles to each other relative to the Earth.
(d) The Moon and Sun are at an angle of 450 to each other relative to the Earth.

50. Consider the following statements regarding the distribution of ocean temperature:
1. Heat transfer from the ocean surface to deeper layers occurs primarily through convection.
2. The average surface temperature of the ocean generally declines as latitude increases.
3. The vertical temperature of the ocean initially increases up to a depth of 200m and then decreases rapidly.
4. The average annual ocean temperature in the Northern Hemisphere is higher than in the Southern Hemisphere.

Which of the statements given above are correct?
(a) 1, 2 and 4 only
(b) 1 and 3 only
(c) 2 and 4 only
(d) 1, 2, 3 and 4

51. Mariana Trench is the deepest known trench that lies in the Pacific Ocean. It is formed due to the convergence and subduction of the 'Pacific Plate' under which of the following plates?
(a) Philippine Plate
(b) Nazca Plate
(c) Australian Plate
(d) Cocos Plate

52. In the Indian Ocean, there is a reversal of direction of ocean currents between summer and winter. What is the primary reason for this?
(a) Gravitational pull of the moon
(b) Change in the intensity of Coriolis force.
(c) Rotation of the Earth
(d) Change in direction of the monsoon winds

53. Consider the following ocean currents:

1. Labrador
2. Brazilian
3. Falkland
4. Benguela
5. Canaries

How many of the above are cold ocean currents?

(a) Only two
(b) Only three
(c) Only four
(d) All five

54. Consider the following statements:

Statement-I: Continental shelves are considered the richest fishing grounds in the world.

Statement-II: Shallowness of the continental shelves allows sunlight to penetrate through the water, promoting the growth of various plants and organisms.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

55. With reference to the movement of Ocean currents, consider the following factors:

1. The Earth's axial tilt towards the Sun.
2. The rotation of Earth on its own axis.
3. The location of Seas within the relatively enclosed spaces.
4. Direction of trade winds as well as Seasonal winds.

How many of the above factors affect the direction and intensity of ocean currents?

(a) Only one
(b) Only two
(c) Only three
(d) All four

56. Which one of the following is the most appropriate reason for the Norwegian coast, remaining ice-free throughout the year, despite being situated at higher latitudes?

(a) Location of this coast at higher elevation compared to other coasts in the same latitudes.
(b) Warming of the coast by the presence of warm ocean current, 'North Atlantic drift'.
(c) The presence of precipitation throughout the year in this area prevents frost formation.
(d) The increased solar radiation is received in this region due to the Earth's axial tilt.

57. With reference to the reef building corals, consider the following statements:

1. They require a minimum surface water temperature of 20°C for survival.
2. A shallow water not exceeding the depth of 100 feet is ideal for their growth.
3. Sediment-rich water provides an ideal habitat for their survival.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

58. Which of the following factors makes emergent seacoasts less suitable for port development?

(a) They have irregular and intended coastline due to intense wave action.
(b) They are typically characterized by estuarine, ria and fjord coasts.
(c) They have raised beaches, steep cliffs and extended continental shelves.
(d) They are characterized by strong tidal currents and frequent storms.

59. Consider the following statements:

Statement I: The highest ocean temperature is recorded slightly towards the south of the equator.

Statement II: Unequal distribution of land and water influences the distribution of temperature of ocean water.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation for Statement I
(b) Both Statement I and Statement II are correct but Statement II is not the correct explanation for Statement I
(c) Statement I is correct, but Statement II is incorrect
(d) Statement I is incorrect, but Statement II is correct

60. With reference to waves in the ocean, consider the following statements:

1. Waves are energy and not actual travelling of water in the oceans.
2. Wind is the primary driving force behind the formation of waves.
3. Wave break occurs when the depth of water is more than twice the wavelength of the wave.
4. Gravity plays an important role in the travelling of waves in the ocean.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2, 3 and 4
(c) 1, 2 and 4
(d) 1 and 4 only

61. Which of the following forces play a significant role in the formation of tides?

1. Centrifugal force of the Earth
2. Gravitational force of the Moon
3. Coriolis force of the Earth
4. Gravitational force of the Sun

Select the correct answer using the code given below:

(a) 1, 2 and 3 only
(b) 1 and 3 only
(c) 2 and 4 only
(d) 1, 2 and 4 only

62. Consider the following statements:

Statement-I: The ocean water is about 8 cm higher in level near the equator than in the mid-latitudes.

Statement-II: Thermal expansion of water, caused by solar heating, is greater near the equator in comparison to mid-latitudes.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

63. Consider the following with reference to ocean currents:

Warm ocean currents are generally found at:

1. East coast of continents in low latitudes
2. West coast of continents in low latitudes
3. East coast of continents in high latitudes
4. West coast of continents in high latitudes

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 and 4 only
(d) 1 and 4 only

64. Consider the following information:

Ocean Current	Type of Ocean Current	Region
1. Benguela Current	Cold current	West coast of Southern Africa
2. Agulhas Current	Warm current	East coast of southern Africa
3. Labrador Current	Warm current	West coast of South America
4. Canary Current	Cold current	Southeast coast of Australia

In how many of the above rows is the given information correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

65. Consider the following statements regarding Ocean Gyres:

1. They are large systems of circular ocean currents formed by global wind patterns and the Coriolis effect.
2. Most of the world's major gyres are located in the polar regions.
3. Western boundary currents within gyres are weaker than eastern boundary currents.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 3 only

66. Consider the following statements with reference to the effects of ocean currents:

1. Cold ocean currents are responsible for rainy climates on the west coast of tropical and subtropical latitudes.
2. The ports of North Western Europe remain ice-free and open throughout the year due to the impact of warm currents.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

67. The Subsidence Theory and the Glacial Control Theory are related to:

(a) Formation of mantle plume
(b) Formation of coral reefs and atolls
(c) Chronological sequencing of fossils
(d) Direction of Gyre circulations

68. Consider the following statements regarding the impact of Downwelling of Ocean Currents:

1. Regions of downwelling generally have low biological productivity.
2. Ekman transport plays an important role in the downwelling of ocean currents.
3. Due to downwelling, hydrogen sulfide is produced at the bottom of the ocean in huge quantities.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

69. Consider the following statements with reference to the effects of ocean currents:

1. Cold Ocean currents result in desert formation in west coast regions of the tropical continents.
2. North Atlantic Drift keeps the coasts of the North Sea warm.
3. The mixing of warm and cold currents favors the growth of plankton.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

70. With reference to Estuaries, consider the following statements:

1. Estuaries are among the lowest productive zones in the world and are the least populated.
2. Estuaries are the ecotone zones where the freshwater mixes with the salt water.

Which of the above-mentioned statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

71. Consider the following statements with reference to the 'Atlantic Meridional Overturning Circulation (AMOC)':

1. It is the movement of ocean water driven by differences in densities.
2. It carries warm surface waters from the tropics to northward in the Atlantic Ocean.
3. The melting of ice shelves in the Artic has caused the AMOC to strengthen.
4. The weakening of the AMOC can result in droughts across Europe.

Which of the statements given above are correct?

(a) 1, 2, and 3 only
(b) 1, 2, and 4 only
(c) 2 and 4 only
(d) 1, 3, and 4 only

72. With reference to 'Southern Ocean', consider the following statements:

1. It is the only ocean that completely encircles the Earth.
2. It has no northern boundary and is fed by water from the other oceans.
3. It is known as 'Global sink' as it plays a vital role in absorbing and storing carbon from the atmosphere.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

73. Which of the following have coral reefs?

1. Lakshadweep
2. Gulf of Kachchh
3. Gulf of Mannar
4. Sunderbans

Select the correct answer using the code given below.
(a) 1, 2 and 3 only
(b) 2 and 4 only
(c) 1 and 3 only
(d) 1, 2, 3 and 4

74. What explains the eastward flow of the equatorial counter-current?
(a) The Earth's rotation on its axis
(b) Convergence of the two equatorial currents
(c) Difference in salinity of water
(d) Occurrence of the belt of calm near the equator

75. With reference to Ocean Currents, consider the following statements:
1. Ocean Currents are stronger at the surface than at the depths.
2. Rotation of Earth have an influence on the movement of Ocean Currents.
3. Difference in water density affect the mobility of Ocean Currents.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

76. Why thermohaline circulation is called as the "global conveyer Belt"?
(a) It drives the tidal movement across the globe.
(b) It results in movement of aquatic biota at global level.
(c) It results in the development of trade wind.
(d) It drives the ocean current in the deep ocean and on the surface.

77. With reference to the bottom ocean topography of Pacific, Atlantic and Indian Ocean, consider the following statements:
1. Ninety East Ridge is found in Pacific Ocean.
2. New Caledonia reef system is located in South Pacific Ocean.
3. Siberian shelf located in Arctic Ocean is the largest continental shelf on the earth.
4. The Pacific Ocean does not have oceanic ridges like Atlantic and Indian Ocean.

Which of the statements given above is/are correct?
(a) 1, 2 and 3 Only
(b) 1, 2 and 4 Only
(c) 2 and 3 Only
(d) 1, 3 and 4 Only

78. Consider the following statements:
1. In the tropical zone, the western sections of the oceans are warmer than the eastern sections owing to the influence of trade winds.
2. In the temperate Zone, westerlies make the eastern sections of oceans warmer than the western sections

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 and 2

79. Consider the following statements:
1. The annual range of temperature is greater in the Pacific Ocean than that in the Atlantic Ocean.
2. The annual range of temperature is greater in the Northern Hemisphere than that in the Southern Hemisphere.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

80. These are the western boundary ocean currents in the wind-driven, subtropical and subarctic circulations of the North Pacific Ocean. One of them is downwelling-dominant, low in biological productivity and is devoid of detritus and other organic material in the surface water, whereas the other is dominated by upwelling and fed by nutrient-rich waters. The confluence of these currents is marked by fogbanks and has a great influence on fisheries and climate in the western North Pacific. These currents are:
(a) Kuroshio Current and Oyashio Current
(b) California Current and Alaska Current
(c) Falkland Current and Humbolt Current
(d) Labrador Current and Gulf Stream

SOLUTIONS

3.1. Movement, Relief, Temperature & Salinity of the Oceans

1. Solution: (b)

Exp) Option b is the correct answer.

Pair 1 is correct: The Mid Ocean Ridges exist in the middle of the ocean basins, where the **divergent plate boundaries are located.** These zones are tectonically active regions and they are the **most active volcanic regions on the earth.**

Pair 2 is incorrect: Seamounts are undersea mountains formed by volcanic activity. Seamounts often have a **high level of biological productivity** because they provide habitats for many species of plants and animals. Over 200 species of sea creatures have been observed at a single guyot in the New England Seamount.

Pair 3 is correct: Submarine Canyons are deep valleys cutting across the continental shelves and slopes, often extending from the mouths of large rivers. The Hudson Canyon is the best-known submarine canyon in the world.

Pair 4 is incorrect: Guyots It is **a flat-topped seamount** whereas the seamounts is a mountain with pointed summits, rising from the seafloor that does not reach the surface of the ocean.

2. Solution: (a)

Exp) Option a is the correct answer.

Ocean currents affect temperature by transporting their heat or coldness into adjacent regions.

Statement 1 is incorrect: El Nino refers to the periodic development of a **warm ocean current along the Peruvian coast** as a temporary replacement for the cold Peruvian Current. The presence of El Nino leads to below average monsoon rainfall in India.

Statement 2 is correct: The presence of canaries, the cold current, on the western coasts of Africa leads to the formation of Sahara Desert in the African region.

Statement 3 is correct: The **cold Labrador Current flows** along the **east coast of America freeze the ports** located in that area for several months. The coastal districts of western Europe are in the same latitude under the influence of warm current, the North Atlantic Drift, keeps their ports ice-free.

Statement 4 is correct: The presence of **warm ocean current along the eastern coast of South America** leads to the formation of grassland vegetation **(Pampas) in** that area.

3. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is incorrect: The maximum temperature of the oceans is always at their surfaces because they directly receive the heat from the sun and the heat is transmitted to the lower sections of the oceans through the process of convection. It results in a **decrease of temperature with the increasing depth, but the rate of decrease is not uniform throughout.** The temperature falls very rapidly up to the depth of 200 m and thereafter, the rate of decrease of temperature is slowed down.

Statement 2 is correct: The oceans in the northern hemisphere record relatively higher temperature than in the southern hemisphere. The average annual temperatures for the northern and southern hemisphere are around 19° C and 16° C respectively. This variation is **due to the unequal distribution of land and water** in the northern and southern hemispheres

Statement 3 is incorrect: The enclosed seas in the **low latitudes** record relatively **higher temperature** than the open seas, whereas the enclosed seas in the **high latitudes** have **lower temperature** than the open seas as the **rate of evaporation decreases** towards the poles **because the amount of solar insolation decreases towards poles.**

Statement 4 is correct: The atmospheric air circulation influences the temperature of the oceans. For instance, under the influence of **westerlies**, the warm **Gulf stream** is driven to the western coast of Europe as the North Atlantic Drift. **North Atlantic drift** flows along the **east coast of the UK as a warm current thus increasing the temperature of the ocean in this region.**

4. Solution: (c)

Exp) option c is the correct answer.

Statement 1 is incorrect: Cold currents flow parallel to the **west coasts** of the continents in **tropical and subtropical latitudes E.g., Canaries current** along the west coast of **Africa. Warm currents** flow parallel to the **east coasts** of the continents in **tropical and subtropical latitudes E.g., Kuroshio current** along the eastern coast of **Asia.**

Statement 2 is correct: Ocean currents are generally referred to by their "drift". **Ocean currents are stronger at the surface and may attain speeds over 5 knots. At depths, currents are generally slow with speed less than 0.5 knots.**

Statement 3 is correct: Mixing of warm and cold current creates **foggy weather** where **precipitation** occurs in the form of **drizzle.** The mixing of **Labrador current (cold current) with Gulf of stream (warm current) causes drizzling in Newfoundland.**

5. Solution: (b)

Exp) Option b is the correct answer

Thermocline is a boundary region in the ocean, from where there is a **rapid decrease of temperature**

Statement 1 is incorrect: Following are the temperature structure of the ocean. The first layer represents the **top layer of warm oceanic water with** temperatures ranging between **20° and 25° C. The second layer comprises thermocline** and the third layer is very cold and extends up to the deep ocean floor.

Statement 2 is correct: The thermocline layer is characterised by **rapid decrease in temperature with increasing depth.** Thermocline region begins around 100 - 400 metres below the sea surface and extends several hundred metres downward.

Statement 3 is correct: In the ocean, the depth and strength of the thermocline vary from season to season and year to year. While it is **semi-permanent in the tropics**, it varies in temperate regions e.g., **thermocline is deepest during the summer in temperate regions.**

Statement 4 is correct: In the Arctic and Antarctic circles, the **surface water temperatures are close to 0° C. Thermocline is shallow to non-existent in the polar regions,** where the water column is cold from the surface to the bottom.

Statement 5 is correct: About **90 per cent of the total volume of water is found below the thermocline, in the deep ocean.**

6. Solution: (a)

Exp) Option a is the correct answer.

Assertion is correct: Oceanic exploration have revealed the life forms do exist even in trenches. For instance, as per study of Mariana Trench which is the deepest location in earth's crust about which although little is known about the life forms living in the Trench but despite the lack of light, acidic and freezing conditions, more than **200 known micro-organisms and small creatures, including crustaceans and amphipods, have been known to be living there.** The three most common organisms at the bottom of the Mariana Trench are xenophyophores, amphipods and small sea cucumbers (holothurians).

Reason is correct: The deep-sea fauna/life form in trenches has found source of energy alternative to sunlight. **To compensate for the absence of photosynthesis, they rely on chemosynthesis carried out by various bacteria**, in which they turn inorganic substances into organic.

Chemosynthesis is the process by which certain microbes create energy by mediating chemical reactions. So the animals that live around hydrothermal vents make their living from the chemicals coming out of the seafloor in the vent fluids.

Some have developed much sharper vision while some have abandoned the need of vision, as they rely on touch and vibration.

7. Solution: (c)

Exp) Option c is the correct answer

Pair 1 is incorrect: The **Humboldt Current**, also called the Peru Current, is a **cold ocean current** that flows north along the **western coast of South America. Benguela** is a cold current that flows along the **western coast of Africa.**

Pair 2 is correct: The Labrador Current is a cold current in the North Atlantic Ocean which flows from the Arctic Ocean south along **the east coast of Canada** near Nova Scotia.

Pair 3 is incorrect: It flows south along the **east coast of Africa**. It forms the western boundary current of the southern Indian Ocean.

Pair 4 is correct: Kuroshio current, also called Japan current, is a strong surface oceanic current of the Pacific Ocean. It **flows along the east coast of Japan**

8. Solution: (b)

Exp) Option b is the correct answer

Statement 1 is correct: Waves travel because **wind pushes the water body** in its course while **gravity pulls the crests** of the waves downward. The falling water pushes the former troughs upward and the the wave moves to a new position.

Statement 2 is incorrect: Waves are actually the energy, not the water as such, which moves across the ocean surface. **Water particles only travel in a small circle as a wave passes.** The **actual motion** of the water beneath the waves is **circular**. It indicates that things are carried up and forward as the wave approaches, and down and back as it passes.

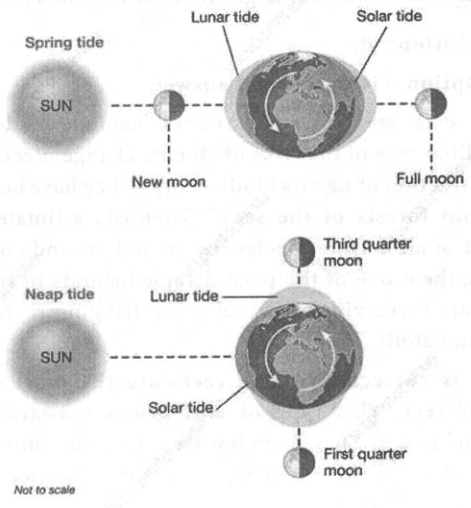
Statement 3 is correct: The **wave breaks** when the **depth of water is less than half the wavelength** of the wave. Wavelength is the horizontal distance between two successive crests.

Statement 4 is incorrect: Waves **continue to grow larger** as they move and **absorb energy** from the wind. This is why **the largest waves are found in the open oceans.**

9. Solution: (c)

Exp) Option c is the correct answer

Statement 1 is incorrect: Spring tides occur when the sun, the moon and the earth are in a straight line and they occur twice a month during **full moon and new moon days**. The **tide** that occurs during this alignment will be **higher.**



Statement 2 is incorrect: Neap tides occur normally 7 days after spring tides when the **sun, the earth and moon are at right angles** to each other. The gravitational pulls of the moon and sun on the earth counteract each other and the resultant tide will be **lower in height.**

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Statement 3 is correct: The position of the sun and moon have a direct bearing on the height of the tide. Spring tide occurs when the sun, the earth and the moon are in straight line hence the resultant tide is higher than the Neap tide.

Statement 4 is correct: Once in a month when the **moon's orbit is much closer to the earth** during **perigee**, unusually high and low tides occur resulting in **higher-than-normal tidal range.**

10. Solution: (c)

Exp) Option c is the correct answer.

Commercial fishing is the activity of catching fish and other seafood for commercial profit, mostly from wild fisheries. It provides a large quantity of food to many countries around the earth, but those who practice it as an industry must often pursue fish far into the ocean under adverse conditions.

Statement 1 is correct: The climate of Japan is modified by the **meeting of warm and cold ocean currents.** It receives **adequate rainfall** from both the South-East Monsoon in summer and the North- West Monsoon in winter (western coasts of Japan). The meeting zone between warm Kuroshio from the south and cold Oyashio from the north produces fog and mist, making north Japan a 'second Newfoundland'. Due to this **fishing becomes more favorable** replacing agriculture as the main occupation in many of the indented coastlands.

Statement 2 is correct: The indented coastline of Japan, provides sheltered fishing ports, calm waters, and safe landing places, ideal for the fishing industry.

Statement 3 is incorrect: The continental shelves around the islands of Japan are rich in plankton, **due to the meeting of the warm Kuroshio and the cold Oyashio currents** and provide excellent breeding grounds for all kinds of fish.

11. Solution: (d)

Exp) Option d is the correct answer.

Coral reefs are important ocean habitats and offer a compelling case of the risks of climate change. Reefs provide a large fraction of Earth's biodiversity—they have been called **"the rain forests of the seas."** Scientists estimate that 25 percent of all marine species live in and around coral reefs, making them one of the most diverse habitats in the world. There are three kinds of coral reefs: fringing reefs, barrier reefs, and atolls.

Pair 1 is correct: Fringing reefs are the most common type of reef. This type of reef grows seaward directly from the shore. They form borders along the shoreline and surrounding islands. A fringing reef is composed of a reef flat and a reef slope. The reef flat is nearest to shore. Due to heavy sediment, few live corals live in the reef flat. **It is mostly made of exoskeletons.** The reef slope faces the open ocean. Most marine life is found on the reef slope.

Pair 2 is correct: A barrier reef is separated from the shore by a lagoon. The reef forms a barrier between the coast and the open ocean or sea. **Barrier reefs are far less common** than fringing reefs or atolls, although examples can be found in the tropical Atlantic as well as the Pacific.

Pair 3 is correct: An atoll is a roughly circular (annular) oceanic reef system surrounding a large (and often deep) central lagoon. When a fringing reef continues to grow upward from a volcanic island that has sunk entirely below sea level, an atoll is formed.

12. Solution: (c)

Exp) Option c is the correct answer.

Ocean currents play a significant role in redistributing heat and salt throughout the world's oceans. They are driven by a combination of factors, including wind, temperature, and the Earth's rotation.

Pair 1 is correctly matched: The Atacama is one of the driest places on earth. It receives less than 1 mm of precipitation each year, and some areas haven't seen a drop of rain in more than 500 years. There are two main reasons for the prevailing dry climatic conditions in Atacama Desert. On one hand Andes Mountains obstruct the moisture laden winds, these winds ascend near the mountains only and bring rains in those regions. The dry winds will rach Atacama Desert. On the other hand, **Humboldt Current, which is a cold ocean current, makes coastal surface water cold and prevents evaporation of the water.** When winds blow from ocean into the land, they will be dry and cold. These dry winds do not bring any rain to the Atacama region.

Pair 2 is correctly matched: The Gulf stream is a warm ocean current that flows from the Gulf of Mexico along the east coast of North America. It is responsible for bringing warm water to the region and has a significant impact on the climate and weather patterns in the area.

Pair 3 is correctly matched: The Canaries current is a cold ocean current that flows off the west coast of Africa, between the Canary Islands and the African mainland. It is known for its strong winds and large waves, which can make navigation in the region difficult.

13. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. The rate of decrease of temperature with depths **is greater at the equator** than at the poles. **Though the surface temperature of the seas decreases from equator towards the poles but the temperature at the ocean bottoms is uniform from the equator towards the pole, which means that the rate of decrease of temperature with increasing depth is more rapid near the equator than towards the poles.**

Statement 2 is correct. The winds blowing from the land towards the oceans drive warm surface water away from the coast resulting in the upwelling of cold water from below.

Statement 3 is incorrect. Whereas the enclosed seas in the high latitudes have lower temperatures than the open seas.

14. Solution: (d)

Exp) Option d is the correct answer

Ocean currents are like **river flow in oceans.** They represent a regular volume of water in a

definite path and direction.

Option 1 is correct: Heating by solar energy causes the water to expand. That is why, near the equator the ocean water is about 8 cm higher in level than in the middle latitudes. This causes a very slight gradient and water tends to flow down the slope. Thus, the latitudinal position of ocean affects the movement of ocean current.

Option 2 is correct: The **Coriolis force** is caused by the **rotation of the earth** on its own axis. The Coriolis force intervenes and causes the **water to move to the right in the northern hemisphere and to the left in the southern hemisphere.**

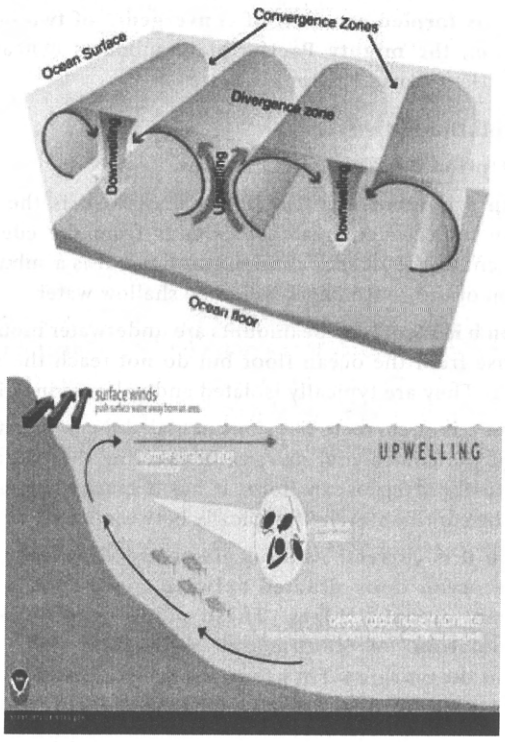
Option 3 is correct: Wind blowing on the surface of the ocean pushes the water to move. Friction between the wind and the water surface affects the **movement of the water body** in its course. For example, **trade winds** influence the direction of ocean current in the ocean.

Option 4 is correct: Differences in water density affect vertical mobility of ocean currents. Water with **high salinity is denser** than water with low salinity. Water with higher density tends to move towards the water with lower density.

Option 5 is correct: The attraction **of the sun and the moon on the earth causes the ocean water to rise up and fall down twice a day**. The vertical motion of the **tides near the shore causes the water to move horizontally**, creating currents. Hence tides too have its influence on ocean currents.

15. Solution: (d)

Exp) Option d is the correct answer



Statement 1 is incorrect: The **winds** blowing from the **land towards the oceans** drive warm surface water away from the coast resulting in the Upwelling of ocean. Water then rises up to replace the water that was pushed away and this process is known as upwelling.

Statement 2 is incorrect: Downwelling occurs in the convergence zone of ocean water and upwelling in the divergence zone. Downwelling occurs when wind blows towards the shore and causes **surface water to build up along a coastline**. During this process, the surface water eventually **sinks toward the bottom.** This water will be warmer and poor in nutrients.

Statement 3 is correct: Subsurface water that rises to the surface as a result of upwelling is typically colder, rich in nutrients, and biologically productive. Good fishing grounds typically are found where upwelling is common. For example, the rich fishing grounds along the **west coasts of Africa and South America are supported by year-round coastal upwelling.**

Statement 4 is correct: During **upwelling** the water that rises to replace the water that has been pushed away is **typically colder.** This will lead to fog near coastal zones. For example, **upwelling in the San Francisco area contributing to the frequent summer fogs.**

16. Solution: (c)

Exp) Option c is the correct answer

Salinity is the term used to define the total content of dissolved salts in seawater. It is calculated as the amount of salt (in gm) dissolved in 1,000 gm (1 kg) of seawater. It is usually expressed as parts per thousand or ppt.

Option 1 is incorrect: Equatorial regions have low salinity because they receive the most rain on a consistent basis. As a result, the fresh water falling into the ocean helps decrease the salinity of the surface water in that region

Option 2 is incorrect: As one moves away from the equator **towards poles, rainfall decreases**. Thus, the **mid latitude regions with less rain and more sunshine, evaporation increases. Evaporation** leads to **loss of fresh water** from the ocean in the form of water vapour causing higher salinity. For example, the **Mediterranean Sea** records higher salinity due to high evaporation.

Option 3 is correct: In the polar region, the influx of **fresh water from melting ice decreases the salinity** of ocean water. For example, **Baltic Sea records low salinity** due to the influx of river waters in large quantities.

17. Solution: (d)

Exp) Option d is the correct answer

Statement 1 is incorrect: The **annual range** of temperatures across the **oceans is low than that of land areas** due to the fact that **water warms up and cools down much more slowly than land.** It is less than 10-degree Fahrenheit for most of the open seas.

Statement 2 is incorrect: There is a reduction of mean annual temperature of the oceans as we go from the equator to the poles. But **this reduction is never constant due to the interference of warm and cold currents, winds and air masses.** Unlike the land areas ocean water is mobile and so there are variations in temperatures across the ocean parts.

18. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: An ocean gyre is a large system of circular ocean currents formed by global wind patterns and forces created by Earth's rotation. Earth's continents and other landmasses (such as islands) can influence the creation of ocean gyres.

Statement 2 is incorrect: The Coriolis force is one of the important factors in causing ocean gyres. Earth's rotation deflects, or changes the direction of the ocean. **The Coriolis effect is not present at the Equator, and winds are the primary creators** of currents. For this reason, the currents in the equatorial region tend to flow in an **east-west pattern instead of circular pattern. Thus, we cannot say that the Gyres** are most prominent at the equator, as compared to higher latitudes.

Statement 3 is incorrect:

Generally, in the Northern Hemisphere the gyres rotate in clockwise direction, while in the Southern Hemisphere the gyres rotate in counter-clockwise direction.

19. Solution: (b)

Exp) Option b is the correct answer.

Continental shelf is a seaward extension of the continent from the shoreline to the continental edge. These extended margins of each continent are occupied by relatively shallow seas and gulfs. Gradient of continental is 1° or even less.

Statement 1 is incorrect. It is the shallowest part of the ocean **showing an average gradient of 1° or even less.** The shelf typically ends at a very steep slope, called the shelf break. The continental slope shows the steeper gradient than continental shelves.

Statement 2 is correct. The width of the Continental Shelves varies greatly. In some places where the coasts are extremely mountainous the continental shelf may be entirely absent. **The Continental shelves are almost absent or very narrow along some of the margins like the coasts of Chile, the west coast of Sumatra, etc**. On the contrary, the Siberian shelf in the Arctic Ocean, the largest in the world, stretches to 1,500 km in width.

Statement 3 is correct. Continental shelves are a major **source of oil deposits around the world**. More than a third of the oil and gas extracted worldwide comes from offshore sources. Petroleum is not distributed evenly around the world. Slightly less than half of the world's proven reserves are located in the Middle East.

Statement 4 is correct. Continental shelves are of great geographical significance. Their shallowness enables sunlight to penetrate through the water, which encourages the growth of minute plants and other microscopic organisms. **The continental shelves are therefore the richest fishing grounds in the world, e.g., the Grand Banks off Newfoundland, the North Sea and the Sunda Shelf.** Their limited depth and gentle slope keep out cold under-currents and increase the height of tides. Most of the world's greatest seaports including Southampton, London, Hamburg, Rotterdam, Hong Kong and Singapore are located on continental shelves.

20. Solution: (a)

Exp) Option a is the correct answer

Option a is correct: Oceanic trenches are formed at **the bases of continental slopes.** These areas are the deepest parts of the oceans. The trenches are relatively steep sided and narrow basins. They are some 3-5 km deeper than the surrounding ocean floor.

Option b is incorrect: Oceanic trenches are associated with **strong earthquakes** and active volcanoes because of the **existence of deep-seated focus of the earthquake in the oceanic trenches.** The focus is the point at which the earthquake originates.

Option c is incorrect: Ocean trenches are found in every ocean basin on the planet, although the **deepest ocean trenches are found in the Pacific** as part of the Ring of Fire Ring of fire region witnesses active volcanoes and earthquakes. As many as 57 deeps have been explored so far; of which 32 are in the Pacific Ocean; 19 in the Atlantic Ocean and **6 in the Indian Ocean.**

Option d is incorrect: Oceanic trenches are commonly formed as a result of convergence of Continental and Oceanic plate. However, it can **rarely** be formed when **two oceanic plates meet. The Mariana Trench, in the South Pacific Ocean, is formed as result of convergence of two oceanic plate i.e., the mighty Pacific plate** subducts beneath the smaller, less-dense **Philippine plate**

21. Solution: (d)

Exp) Option d is the correct answer.

Option a is incorrect: The continental shelf is the gently sloping underwater area that extends from the edge of a continent to the steeper continental slope. It is a submerged portion of the continent, covered by shallow water.

Option b is incorrect: Seamounts are underwater mountains that rise from the ocean floor but do not reach the water's surface. They are typically isolated and volcanic in origin.

Option c is incorrect: The continental slope is the steepest part of the continental margin, connecting the continental shelf to the deep ocean floor. It has a much steeper slope than the continental shelf, typically between 2 and 5 degrees.

Option d is correct: Abyssal plains are vast, flat regions on the ocean floor situated between continental margins and mid-oceanic ridges. These plains result from the accumulation of continental sediments that extend beyond the margins. They form expansive, level landscapes, contributing to the ocean's topographical diversity and playing a crucial role in geological processes.

22. Solution: (b)

Exp) Option b is the correct answer.

Coastal upwelling is an oceanographic phenomenon that involves the **upward movement of nutrient-rich deep waters towards the ocean's surface**, providing a vital source of sustenance for a diverse array of marine life.

Statement 1 is incorrect: Coastal upwelling **facilitates the movement of nutrient-rich deep water to the surface,** fostering an environment **conducive to the growth of phytoplankton, seaweed, and other primary producers.** These primary producers form the foundation of the marine food web, supporting the growth of zooplankton and other marine organisms.

Statement 2 is correct: Nutrient-rich waters resulting from coastal upwelling **create highly productive fishing grounds.** The increased availability of food resources supports a thriving community of fish, marine mammals, and birds. This phenomenon is exemplified by regions like the **west coast of Peru**, where continual coastal upwelling contributes to one of the richest fishing grounds globally. Overall, **coastal upwelling regions only cover 1 percent of the total area of the world's oceans, but they provide about 50 percent of the fish harvests.**

23. Solution: (d)

Exp) Option d is the correct answer.

Oceanic gyres are expansive systems of circulating ocean currents that play a crucial role in the global movement of seawater. These large-scale gyres are characterized by their circular or spiral patterns, **influencing the distribution of heat, nutrients, and marine life across the world's oceans.**

Statement 1 is incorrect: In the **Northern Hemisphere, these currents move in a clockwise direction,** while **in the Southern Hemisphere, they circulate counterclockwise. This** rotation is a result of the **Coriolis effect**, a phenomenon caused by the Earth's rotation.

Statement 2 is incorrect: The oceanic gyres are not typically considered the most productive regions of the ocean. **The central areas of gyres tend to have lower nutrient concentrations, limiting primary productivity.** However, the outer edges of gyres, where upwelling occurs, can be rich in nutrients, supporting diverse marine life.

Statement 3 is incorrect: The Sargasso Sea, often associated with oceanic gyres, is located in the **North Atlantic Ocean.** It is characterized by its calm waters. It is enclosed on the west by the **Gulf Stream**, on the north by the **North Atlantic Drift**, on the east by the **Canary Current**, and on the south by the **North Atlantic Equatorial Current.**

24. Solution: (c)

Exp) Option c is the correct answer.

A guyot, **also known as a table mount or flat-topped seamount**, is a type of underwater mountain or seamount with a distinct **flat or gently sloping summit**. Guyots are characterized by their **plateau-like features**, in contrast to the pointed or peaked summits of typical seamounts. The flat top of a guyot is often believed to **result from the processes of erosion and subsidence.**

The formation of a guyot typically involves the following stages:

1) An underwater volcanic seamount forms with a conical peak, but over time, through **erosion caused by wave action and other geological processes, the summit becomes flattened.**
2) The guyot **gradually subsides or sinks beneath the ocean surface**. This combination of processes results in the **distinctive flat-topped structures**, called guyots.

25. Solution: (b)

Exp) Option b is the correct answer.

The major ocean currents in the globe play a crucial role in regulating Earth's climate, distributing heat and nutrients, and influencing weather patterns.

Statement 1 is incorrect: El Nino refers to the periodic development of a warm ocean current along

the Peruvian coast as a temporary replacement for the cold Peruvian Current. **The presence of El Nino leads to below average monsoon rainfall in India.**

Statement 2 is correct: The **Cold Canary Current** is an ocean current that flows southwards along the **western coast of Africa** and extends towards the equator. The presence of this current in the region led to the formation of the **Sahara Desert in the African region.** Unlike warm currents, cold currents do not give rise to moisture laden winds and hence there is no rainfall in the coastal areas. These currents give rise to conditions which are the cause of desertification in the affected coastal areas.

Statement 3 is correct: Mixing of warm and cold current creates foggy weather where precipitation occurs in the form of drizzle. For example, the mixing of Labrador current (cold current) with Gulf of stream (warm current) causes drizzling in Newfoundland.

26. Solution: (a)

Exp) Option a is the correct answer.

Both surface and deep-water currents are integral components of the Earth's climate system, with each playing a distinct yet interconnected role in regulating global climate patterns.

Statement 1 is correct: Deep water currents are primarily driven by density differences in ocean waters, a process known as thermohaline circulation, which is influenced by variations in temperature and salinity. **Surface water currents**, on the other hand, are primarily driven by **wind stress,** which is the frictional force exerted by wind on the ocean surface.

Statement 2 is correct: Deep water currents typically move at much slower speeds compared to surface water currents. Surface currents can reach speeds of up to several knots, while deep water currents typically move at a few centimetres per second. This difference in speed is attributed

to the **increased viscosity and resistance at deeper levels of the ocean.**

Statement 3 is incorrect: Both the surface and deep-water currents have a significant impact on the global climate. For example, the **deep-water currents** circulate cold, dense water from the poles towards the equator and then back again, creating a **global conveyor belt system that plays a crucial role in maintaining global climate.**

27. Solution: (d)

Exp) Option d is the correct answer

Salinity is the term used to define the total content of dissolved salts in seawater. It is calculated as the amount of salt (in gm) dissolved in 1,000 gm (1 kg) of seawater. It is usually expressed as parts per thousand or ppt.

Option 1 is incorrect: Equatorial regions have low salinity because they receive the most rain on a consistent basis. As a result, the fresh water falling into the ocean helps decrease the salinity of the surface water in that region.

Option 2 is incorrect: As one moves away from the equator **towards poles, rainfall decreases.** Thus, the **mid latitude regions with less rain and more sunshine, evaporation increases. Evaporation** leads to **loss of fresh water** from the ocean in the form of water vapour causing higher salinity. For example, the **Mediterranean Sea** records higher salinity due to high evaporation.

28. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct. Mid-oceanic ridges are created at divergent plate boundaries, where two tectonic plates move away from each other due to mantle convection forces. As the plates separate, magma from the mantle rises, cools, and solidifies to form a new oceanic crust, leading to seafloor spreading. The Mid-Atlantic Ridge (between the Americas and Europe/Africa) and the East Pacific Rise are classic examples.

Statement 2 is correct. The **Mid-Oceanic Ridge System is the longest continuous mountain chain on Earth, stretching over 65,000 km across the ocean floors.** It is longer than any land-based mountain range, including the Himalayas, Andes, and Rockies. In some places, parts of the ridge rise above sea level, such as Þingvellir National Park,Iceland, which sits on the Mid-Atlantic Ridge.

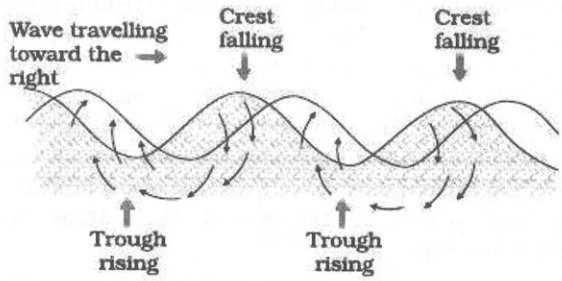
Statement 3 is correct. Hydrothermal vents are hot, mineral-rich springs located along mid-oceanic ridges, where seawater seeps into the Earth's crust, gets heated by magma, and is released back into the ocean with dissolved minerals. **These vents create unique deep-sea ecosystems,** where organisms like giant tube worms, extremophile bacteria, and deep-sea crabs survive without sunlight by using chemosynthesis instead of photosynthesis.

29. Solution: (b)

Exp) option b is the correct answer.

Ocean waves are energy-driven movements of water that travel across the ocean surface. Unlike ocean currents, which involve the mass movement of water, waves primarily transfer energy, not water itself. The movement of waves is best described as an **oscillatory motion,** where water particles move in **circular orbits** as the wave passes.

Statement 1 is correct. The primary force responsible for the movement of ocean waves is the frictional force of the wind acting on the water surface. Most ocean waves are generated by wind, which **creates frictional drag on the water surface,** causing energy transfer. Stronger winds result in **larger and faster-moving waves. Other forces,** such as earthquakes and underwater volcanic eruptions, can also generate waves, but wind-driven waves are the most common.



Motion of waves and water molecules

Statement 2 is incorrect. The largest waves occur in the open ocean, not in marginal seas. The open ocean has **uninterrupted wind flow over long distances ("fetch"),** allowing waves to grow much larger. **Marginal seas (like the Mediterranean Sea, Bay of Bengal, or the South China Sea) have restricted areas, meaning waves cannot build up to massive sizes like those in open oceans.**

Statement 3 is correct. Waves break when they enter shallow waters, where the depth of water is less than half their wavelength. As the wave approaches the shore, **the bottom part slows down due to friction with the seafloor,** while the **top part continues moving at the same speed, causing the wave to collapse forward.** This process is known as **wave breaking,** which creates **surf zones and coastal erosion.**

30. Solution: (d)

Exp) Option d is the correct answer.

The Sargasso Sea is located entirely within the Atlantic Ocean. It is the only sea without a land boundary. The Sargasso Sea is a vast patch of ocean named for a genus of free-floating seaweed called Sargassum.

Option d is correct.

While all other seas in the world are defined at least in part by land boundaries, **the Sargasso Sea is defined only by ocean currents.** It is bounded by the oceanic currents of the North Atlantic Gyre. These ocean currents are circulating clockwise around a central gyre of deep water.

The Sargasso Sea is bounded by: Gulf Stream; Canary Current; North Atlantic Equatorial Current and North Atlantic Current.

1. The Gulf Stream establishes the Sargasso Sea's western boundary,
2. It is bounded to the north by the North Atlantic Current
3. To the east it is bordered by the Canary Current,
4. To the south by the North Atlantic Equatorial Current.

Important Tips

The Sargasso Sea is unique in that it harbors species of sargassum that are 'holopelagic'. This means that the algae not only freely floats around the ocean, but it reproduces vegetatively on the high seas. Other seaweeds reproduce and begin life on the floor of the ocean.

31. Solution: (a)

Exp) Option a is the correct answer.

Trenches are the deepest parts of the oceans. The trenches are relatively steep sided, narrow basins. They are some 3-5 km deeper than the surrounding ocean floor.

Statement 1 is correct: Trenches are of tectonic origin and are formed during ocean – ocean convergence and ocean continent convergence. **Earthquakes are frequent in trench regions**. The subduction process at these boundaries is a major source of seismic activity. As one plate slides beneath another, it generates significant friction and stress, leading to earthquakes.

Statement 2 is incorrect: Lifeforms do exist in trenches. These ecosystems are home to a variety of specially adapted organisms that thrive under these harsh conditions. Many fish species have adapted to life in these dark ocean trenches. Some use bioluminescence, meaning they produce their own "living light" in order to attract prey, find a mate, or repel a predator.

32. Solution: (c)

Exp) Option c is the correct answer.

Tides, the periodic rise and fall of the ocean's surface, play a crucial role in shaping our planet's coastal environments and influencing human activities in profound ways. Tides hold immense importance, extending to various advantages such as **supporting the livelihoods of fishing communities.**

Option a is incorrect: The abundance of fishes during low tides are less compared to that of high tides because deeper pools and wider ocean connections at high tide allow more fishes to enter the region. Further the **exposed seabed (during low tide) can damage the net** and rendering it less preferred action for the fisherman.

Option b is incorrect: High tide generally expands the available habitat for fish as water covers ground. While there might be more space for fish to move during high tide, it could be more **challenging for the fisherman to locate and catch fishes due to their spread-out distribution.**

Option c is correct: After high tide, as the water recedes, **fishes might move towards shallower areas**. Casting the net shortly after high tide could target actively feeding fish in these shallower regions, thus maximising the catch of the fisherman.

Option d is incorrect: Increased water movement can stimulate fish activity and attract them to areas of the net. However, casting a net **during strong currents can be difficult and dangerous, especially for small boats.**

33. Solution: (c)

Exp) Option c is the correct answer.

Statement-I is correct: Spring tides happen when the sun and moon's gravity pull together, making the ocean tides **higher than usual. Neap tides** occur when the gravitational forces of the sun and the moon are at right angles to each other, weakening their combined pull on the oceans, leading to **lower-than-average tides.**

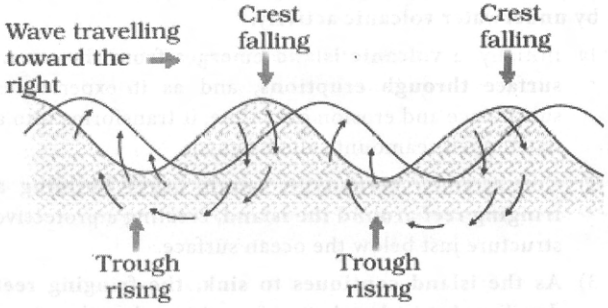
Statement-II is incorrect: Spring tides typically occur around the time of the **new moon and the full moon** when the Sun, Moon and Earth are in straight lines. On the other hand, **neap tides** typically occur normally **7 days after spring tides when the sun, the earth and the moon are at right angles to each other.**

34. Solution: (a)

Exp) Option a is the correct answer.

Ocean waves are the up and down movement of water in the ocean. These travel through the vast expanses of the Earth's oceans. **They represent a complex interplay of energy transfer through water**, influenced by atmospheric conditions, wind patterns, and the underlying topography of the ocean floor.

Statement 1 is incorrect: The oceanic waves are the **transfer of energy** through the medium of water. As waves move through the water, **individual water particles generally oscillate in place,** passing the energy along rather than undergoing significant horizontal movement. This implies that **water does not actually travel in waves. Waves transmit energy, not water.** This is why a floating object, like a boat, will bob up and down as a wave passes but won't necessarily be carried far horizontally.



Movement of waves and water molecules

Statement 2 is incorrect: Wavelength is the horizontal distance between two successive crests (the highest point of a wave). **While approaching the seashore, the waves typically break when the depth of the water is approximately equal to half the wavelength.** When waves approach shallower waters, the lower part of the wave slows down due to the interaction with the sea floor. This is due to the friction occurring between the dynamic water and the sea floor.

Statement 3 is correct: Wind is a significant factor in generating waves. **The stronger the wind, the more energy is transferred to the water surface, resulting in larger waves**. Factors such as the duration and fetch (the distance over which the wind blows) also play a role in determining wave height. Once generated, waves can travel across vast distances, **carrying the energy imparted by the wind.**

35. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: An atoll is a **ring-shaped coral reef or island**, which surrounds a body of water called a lagoon. An atoll **also includes a series of islets**. Channels linking islets connect the lagoon to the open ocean or sea.

Statement 2 is incorrect: While hard corals build atolls' foundation with their rigid skeletons, soft corals play a supporting role. They trap sediment, form symbiotic relationships with algae that produce calcium carbonate, create habitat for other organisms, and fill gaps between hard coral colonies. Though hard corals are the primary builders, soft corals contribute significantly to creating the favorable conditions necessary for atoll formation.

Statement 3 is correct: Atolls are frequently located in regions characterized by high wave energy and robust oceanic currents. Warm tropical waters, often associated with regions featuring **strong wave action and ocean currents, create an optimal habitat for the growth of hermatypic corals**. These corals, instrumental in building the reef structure of atolls, thrive in such dynamic marine environments. The continuous interaction between the energetic waves, powerful currents, and the coral ecosystem contributes to the formation of atolls in these specific regions.

Important Tips

Process of atoll formation:

Atolls form through a gradual geological process **initiated by underwater volcanic activity.**

1) Initially, a **volcanic island emerges from the ocean surface through eruptions**, and as it experiences subsidence and erosion over time, it transforms into a flat-topped seamount called a guyot
2) Concurrently, **hermatypic corals begin building a fringing reef around the island**, creating a protective structure just below the ocean surface.
3) **As the island continues to sink, the fringing reef develops into a barrier reef**, positioned farther from shore with a deeper lagoon. Eventually, the volcanic island disappears, leaving behind a ring-shaped coral reef, or atoll, with a central lagoon enclosed by the matured barrier reef.

36. Solution: (a)

Exp) Option a is the correct answer.

Continental shelf is a seaward extension of the continent from the shoreline to the continental edge. These extended margins of each continent are occupied by relatively shallow seas and gulfs. Gradient of continental is of 1° or even less.

Statement 1 is incorrect. Continental Shelf is the shallowest part of the ocean **showing an average gradient of 1° or even less.** The shelf typically ends at a very steep slope, called the shelf break. The continental slope shows the steep gradient than continental shelves.

Statement 2 is incorrect: Continental shelves **cover less than 10 percent of the total area** of the oceans. They do not constitute more than 50 percent of the total area of the oceans. They are relatively shallow and extend from the coastline to the shelf break, but the majority of the ocean's area is occupied by the deeper regions beyond the continental shelves.

Statement 3 is correct. The width of the Continental Shelves varies greatly. In some places where the coasts are extremely mountainous the continental shelf may be entirely absent. **The Continental shelves are almost absent or very narrow along some of the margins like the coasts of Chile, the west coast of Sumatra, etc.** On the contrary, the Siberian shelf in the Arctic Ocean, the largest in the world, stretches to 1,500 km in width.

37. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: The Dead Sea is **one of the saltiest bodies of water on the Earth**. The **Dead Sea has salinity of 34%**, whereas the Mediterranean Sea (located on almost the same latitudes) has salinity levels at 3.8%. **Earth's oceans also have an average salinity of 3.5%.** This salinity of Dead Sea also creates a harsh environment that's inhospitable to plants and animals.

Statement 2 is correct: The Dead Sea is **landlocked between Jordan and Israel** and experiences **high rates of evaporation.** The Dead Sea's main tributary is the river Jordan. **Water flows into the Dead Sea from the river but has no way to get out.** The landlocked position of the sea leads to **accumulation of minerals and salts.** Also, the Dead Sea **receives very little rain,** so the water that evaporates is not replaced quickly.

38. Solution: (b)

Exp) Option b is the correct answer.

Deltas are wetlands that form as rivers empty their water and sediment into another body of water, such as an ocean, lake, or another river. Deltas are formed due to the **slow and steady flow of rivers.** As rivers approach their mouths or ends, the decrease in velocity leads to the deposition of sediment, giving rise to deltas.

Statement 1 is incorrect: While deltas are commonly formed when rivers empty into oceans or seas, they **can also form when rivers empty into lakes or other rivers**. However, inland deltas, which empty into a plain, are **extremely rare.** The **Okavango Delta in Botswana** is probably the most well-known inland delta. It is so unusual that it is recognized as one of the "Seven Natural Wonders of Africa." Water from

the Okavango River never reaches another body of water. The delta spreads water and silt across a flat plain in the Kalahari Desert before getting evaporated.

Statement 2 is correct: Tidal actions enhance sediment deposition and contribute to the formation of deltas. These deltas are **usually formed in the areas with large tidal range** (i.e. an area between high tide and low tide). For example, the **Ganges-Brahmaputra Delta is a tide-dominated delta,** caused due to rise and fall of tides in the Bay of Bengal. However, **sometimes tide also limits the formation of delta.** For example, the **river Amazon does not form a delta**. This is because the tides of Atlantic Ocean are too strong to allow silt to create a delta on the river.

Important Tips

Deltas are often highly suitable for agricultural activities because of the accumulation of nutrient-rich sediments. The sediment, known as alluvium or silt, is rich in nutrients that support the growth of plants. Examples include the Ganges-Brahmaputra Delta in India and Bangladesh, where crops like rice and tea thrive. **Deltas are known for their fertile soil, making them important agricultural regions.**

39. Solution: (b)

Exp) Option b is the correct answer.

Pair 1 is correct: The Mid Ocean Ridges exist in the middle of the ocean basins, where the **divergent plate boundaries are located.** These zones are tectonically active regions and they are the **most active volcanic regions on the earth.**

Pair 2 is incorrect: Seamounts are undersea mountains formed by volcanic activity. Seamounts often have a **high level of biological productivity** because they provide habitats for many species of plants and animals. Over 200 species of sea creatures have been observed at a single guyot in the New England Seamount.

Pair 3 is correct: Submarine Canyons are deep valleys cutting across the continental shelves and slopes, often extending from the mouths of large rivers. The Hudson Canyon is the best-known submarine canyon in the world.

Pair 4 is incorrect: Guyots It is **a flat-topped seamount** whereas the seamounts is a mountain with pointed summits, rising from the seafloor that does not reach the surface of the ocean.

40. Solution: (c)

Exp) Option c is the correct answer.

A lagoon is a shallow body of water protected from a larger body of water (usually the ocean) by sandbars, barrier islands or coral reefs. It is an elongated narrow saline – water lake. It provides security to coast which is associated with the sea even after its formation. Such lakes which are found at the conjunction of bars and beaches are known as lagoons. When barrier bars and spits form at the mouth of a bay and block it, a lagoon forms. The lagoons would gradually get filled up by sediments from the land giving rise to a coastal plain.

41. Solution: (c)

Exp) Option c is the correct answer.

The temperature of ocean water varies by location, both in terms of latitude and depth, due to variations in solar radiation and the physical properties of water. At low latitudes, near the equator, direct overhead sunlight received all year warms surface waters. At high latitudes, ocean waters receive less sunlight.

Statement I is correct: The highest surface temperatures in the oceans are **not recorded precisely at the equator but slightly north of it.** This is due to a combination of factors, including the **angle of the sun's rays, the distribution of land and water, and the circulation patterns of the atmosphere.** The angle of the sun's rays is more direct in the Tropics, leading to greater heating of the Earth's surface. The circulation patterns of the atmosphere, such as the Hadley cell circulation, contribute to the concentration of heat in the Tropics.

Statement II is incorrect: The **freshwater discharge through rivers is not maximum near the equatorial ocean region.** The maximum freshwater discharge occurs in the tropical regions, which are located between 23.5°N and 23.5°S latitudes.

42. Solution: (c)

Exp) Option c is the correct answer

Statement 1 is correct: An isthmus is a narrow strip of land that connects two larger landmasses and separates two bodies of water, for example the Isthmus of Panama in Panama links the continents of North and South America and separates the Pacific and Atlantic Oceans.

The **Strait** is a navigable waterway that **connects two larger bodies of water,** for example **Bering strait** which connects the Arctic Ocean and Pacific Ocean.

Statement 2 is correct: It is true that Isthmus can be formed because of depositional activities by the Ocean, for example the New Zealand Isthmus formed as waves and tides slowly build up a sandbar to create a permanent link between a coastal island and the mainland.

Statement 3 is correct: The Straits **can be formed because of tectonic activity**, for example the Strait of Gibraltar that links the Mediterranean Sea and the Atlantic Ocean.

43. Solution: (d)

Exp) Option d is the correct answer.

"Sodium chloride" contributes the maximum to the salinity of seawater. Sodium chloride, commonly known as table salt, accounts for approximately 77.7% of the total salts in seawater.

Share of different salts is as shown below—

- sodium chloride — 77.7%
- magnesium chloride—10.9%
- magnesium sulphate —4.7%
- calcium sulphate — 3.6%
- potassium sulphate — 2.5%

44. Solution: (d)

Exp) Option d is the correct answer.

The Earth's oceans are dynamic and intricate systems, where various natural phenomena interact to shape their temperature distribution.

Option 1 is correct: Ocean currents play a significant role in the horizontal distribution of temperature. They transport warm water from the equator toward the poles and cold water from the poles toward the equator, influencing the overall temperature patterns in the oceans.

Option 2 is correct: the temperature of surface water decreases from the equator towards the poles because **the amount of insolation decreases poleward**.

Option 3 is correct: the oceans in the northern hemisphere receive more heat due to their contact with a larger extent of land than the oceans in the southern hemisphere. Hence proximity to land is also a factor affecting distribution of temperature of water in oceans.

Option 4 is correct: Winds can **influence the distribution of temperature by driving ocean currents.** The wind-driven surface currents **help redistribute heat** across the oceans, affecting temperature patterns.

45. Solution: (d)

Exp) Option d is the correct answer.

The thermocline is a significant feature of the ocean's temperature structure, acting as a boundary between the warm surface waters and the colder deep ocean.

Statement 1 is incorrect: The **thermocline is the layer where there is a rapid decrease in temperature with increasing depth, not an increase.** The development of a thermocline is mainly caused by heat exchange between water and atmosphere, stratification due to differences in water density, and seasonal variations that affect water temperature and mixing.

Statement 2 is correct: The **thermocline typically begins at a depth of 100–400 meters and extends several hundred meters downward.**

Statement 3 is correct: In the ocean, the depth and strength of the thermocline vary from season to season and year to year. It is semi-permanent in the tropics, variable in temperate regions (often deepest during the summer), and **shallow to nonexistent in the polar regions, where the water column is cold from the surface to the bottom.** In the Arctic and Antarctic regions, the thermocline is often weak or absent due to the cold surface temperatures, resulting in minimal temperature change with depth. In these regions , the surface water temperatures are close to 0° C and so the temperature change with the depth is very slight. Here, only one layer of cold water exists, which extends from surface to deep ocean floor.

46. Solution: (d)

Exp) Option d is the correct answer.

All waters in nature, whether rain water or ocean water, contain dissolved mineral salts. Salinity is the term used to define the total content of dissolved salts in sea water (Table 12.4). It is calculated as the amount of salt (in gm) dissolved in 1,000 gm (1 kg) of seawater. It is usually expressed as parts per thousand (o/oo) or ppt. Salinity is an important property of sea water. Salinity of 24.7 o/oo has been considered as the upper limit to demarcate 'brackish water'.

Factors affecting ocean salinity are mentioned below:

(i) The salinity of water in the surface layer of oceans depends mainly on evaporation and precipitation.

(ii) Surface salinity is greatly influenced in coastal regions by the fresh water flow from rivers, and in polar regions by the processes of freezing and thawing of ice. **(Options 2 and 4 are correct)**

(iii) Wind also influences salinity of an area by transferring water to other areas. **(Option 3 is correct)**

(iv) The ocean currents contribute to the salinity variations. Salinity, temperature and density of water are interrelated. Hence, any change in the temperature or density influences the salinity of water in an area. **(Option 1 is correct)**

47. Solution: (d)

Exp) Option d is the correct answer.

Lake Van is the second-largest lake in the Middle East and is situated in Turkey. It is known for its high salinity level. The lake is located in the region of eastern Anatolia. It is located in an enclosed basin with no outlet, which contributes to its high salt concentration. Lake Van's salinity level is around 330 parts per thousand (o/oo), making it one of the most saline lakes in the world.

Important Tips

1. **Great Salt Lake** is located in Utah, United States, it is the largest natural lake west of the Mississippi River. Its salinity level varies but is generally around 27%.
2. **Lake Rebta** (also known as Lake Retba) is located in Senegal, it is known for its pink color due to the presence of Dunaliella salina algae. Its salinity level is around 40%.
3. **Lake Eyre** is located in Australia, it is the lowest point in the country and is usually dry. When filled with water, its salinity level varies.

48. Solution: (c)

Exp) Option c is the correct answer.

Salinity refers to the total amount of dissolved salts in seawater, typically measured as the mass of salt (in grams) dissolved in 1,000 grams (1 kg) of seawater. It is commonly expressed in parts per thousand (‰ or ppt). The salinity of seawater is influenced by factors such as evaporation, precipitation, freshwater inflow, wind, and ocean currents. As a result, salinity levels vary across different regions of the globe, creating distinct patterns in ocean waters.

Statement I is correct: The North Sea experiences higher salinity than the Baltic Sea despite both being located

in similar northern latitudes, both situated in northern Europe. They are located close to each other, with the North Sea lying to the south west of Scandinavia and the Baltic Sea to the east.

Statement II is incorrect: The North Sea is not an endorheic sea. It has a natural outlet and is connected to the Atlantic Ocean through the English Channel and the Norwegian Sea. **The North Sea has higher salinity due to the inflow of saline water brought by the North Atlantic Drift.** In contrast, the **Baltic Sea experiences lower salinity because of the large influx of freshwater from rivers.**

Thus, while the North Sea's salinity is increased by the North Atlantic Drift, the Baltic Sea's salinity is reduced by the substantial freshwater input.

Hence option c is correct: Statement I is correct, but Statement II is incorrect.

49. Solution: (b)

Exp) option b is the correct answer.

Tides are the **periodic rise and fall of sea levels** caused by the **gravitational pull of the Moon and the Sun on Earth's oceans**. The magnitude of tides depends on the **alignment of these celestial bodies**. The highest tides, known as **Spring Tides**, occur when the **gravitational forces of the Moon and Sun align**, leading to **greater water displacement**.

Option a is incorrect. When **the Moon, Sun, and Earth are in a straight line, with the Moon and Sun on opposite sides of the Earth, it results in Spring Tides (Full Moon position)** because the Sun and Moon's gravitational forces still combine. However, the highest tides **typically occur during the New Moon phase.**

Option b is correct. When the **Moon and Sun are on the same side of the Earth (New Moon position)**, their combined gravitational pull causes the **highest high tides and the lowest low tides**. The force by the moon and sun do not counter each other and it results in the highest of the spring tides.

Option c is incorrect. When the **Moon and Sun form a right angle with Earth (First or Third Quarter Moon phases)**, their gravitational forces partially cancel each other out. This results in **Neap Tides**, where **high tides are lower and low tides are higher than usual.**

Option d is incorrect. When the **Moon and Sun are** at an angle of 450 to each other relative to the Earth then higher spring tide does not occur.

50. Solution: (a)

Exp) Option a is the correct answer.

Ocean waters absorb solar energy similar to land, resulting in spatial and vertical temperature variations across different oceans. Horizontal temperature distribution refers to the variation in ocean surface temperatures along latitudinal lines. The temperature-depth profile of ocean water indicates a gradual decrease in temperature with increasing depth.

Statement 1 is correct: Heat transfer from the ocean surface to deeper layers occurs **mainly through** the process of **convection.** In the ocean, the sun heats the surface water, making it warmer and less dense than the water below. This temperature difference drives convection currents, where the warm, less dense surface water rises, and cooler, denser water sinks, facilitating heat transfer to deeper layers.

Statement 2 is correct: The average surface water temperature is around 27°C, **gradually decreasing from the equator to the poles. The rate of decrease of temperature with increasing latitude is generally 0.5°C per latitude**

Statement 3 is incorrect: The vertical temperature of the ocean does not increase with depth; rather, it decreases. The surface layer has the highest temperature as it directly absorbs solar radiation. Heat is transferred downward, causing a gradual decline in temperature with depth. **This decrease is most rapid up to 200 meters**, after which the rate of decline slows considerably.

Statement 4 is correct: The average annual temperatures are higher in the Northern Hemisphere (approximately 19°C) **than in the Southern Hemisphere(around 16°C).** This variation is due to the unequal distribution of land and water in the northern and southern hemispheres.

51. Solution: (a)

Exp) Option a is the correct answer.

Oceanic trenches are the result of convergent plate boundaries where two tectonic plates collide. This convergence often leads to the phenomenon of **subduction**, where the denser oceanic plate is thrust beneath the lighter continental or other oceanic plate.

Mariana Trench is situated in the western Pacific Ocean near the Mariana Islands. Extending over 2,550 kilometers (1,580 miles) in length and with depths reaching beyond 10,900 meters (35,760 feet) at its lowest point (**the Challenger Deep**), is the **deepest known trench on Earth**.

The Mariana Trench is formed due to the subduction of the Pacific Plate beneath the smaller, less-dense Philippine Sea Plate. As the Pacific Plate, carrying denser oceanic crust, collides with the Philippine Sea Plate, the former is forced beneath the latter. This downward movement of the Pacific Plate into the Earth's mantle creates a trench on the ocean floor, carving out the Mariana Trench's distinct topography.

52. Solution: (d)

Exp) Option d is the correct answer.

The primary reason for the reversal of direction of ocean currents in the Indian Ocean between summer and winter is the **change in direction of the monsoon winds**. During the winter season, the North-East Monsoon winds blow from land to the ocean, producing westward blowing currents. However, during the summer season, there is a complete reversal in the direction of monsoon winds. The north-easterly direction of winter monsoon winds becomes south-westerly, which also reverses the direction of ocean currents.

This **phenomenon is unique to the Indian Ocean** due to the significant influence of the South Asian Monsoon. The monsoonal winds are driven by the difference in temperature

between the land and the ocean, which changes with the seasons. As a result, the currents of the Indian Ocean, which make up the Indian Ocean gyre, are directly affected, causing reversal.

53. Solution: (c)

Exp) Option c is the correct answer.

Cold ocean currents originate in polar or subpolar regions, and transport cold water from higher latitudes to lower latitudes. Examples of Cold Ocean currents include; **Humboldt or Peruvian current, Oyashio, California, antarctica, Okhotsk, labrador, canary, Benguela, Falkland.**

Option 1 is correct: Labrador Current is a cold oceanic current in the North Atlantic Ocean. It originates in the Labrador Sea off eastern Canada and flows southward along the coast of Labrador and Newfoundland before merging with the Gulf Stream.

Option 2 is incorrect: Brazilian Current is a warm oceanic current in the South Atlantic Ocean. It flows southward along the eastern coast of South America, transporting warm tropical waters southward.

Option 3 is correct: Falkland Current is a cold oceanic current in the South Atlantic Ocean. It flows northward along the eastern coast of South America, near the Falkland Islands. It originates from the Antarctic Circumpolar Current and brings cold waters northward along the coast.

Option 4 is correct: Benguela Current is a cold oceanic current in the South Atlantic Ocean. It flows northward along the western coast of southern Africa. The Benguela Current is driven by the southwesterly winds along the coast, which cause coastal upwelling of cold, nutrient-rich waters.

Option 5 is correct: Canaries Current is a cold oceanic current in the North Atlantic Ocean. It flows southward along the western coast of Africa, near the Canary Islands. The Canaries Current is formed by the Canary Island Archipelago blocking the warm waters of the North Atlantic Current, diverting them westward and allowing colder waters from the north to flow southward along the coast.

Important Tips

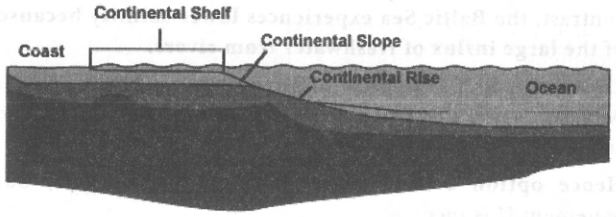
Warm Ocean Current: A warm ocean current is a large body of water that flows from low-latitude regions toward higher latitudes, characterized by higher temperatures compared to the surrounding waters. They are found generally along the east coasts of continents in the low and middle latitudes of both hemispheres. However, in the Northern hemisphere, they are also found along the west coasts of continents of high latitudes. These currents originate in tropical or subtropical regions where the water is warm and less dense due to higher temperatures and lower salinity.

Its examples include the **Gulf Stream and North Atlantic drift in the North Atlantic Ocean, Brazil current in the south Atlantic Ocean, the Kuroshio and, East Australian current in south Pacific Ocean.**

54. Solution: (a)

Exp) Option a is the correct answer.

A continental shelf refers to the submerged edge of a continent beneath the ocean surface. The true boundary of a continent is not its coastline but rather the edge of the continental shelf. These shelves exhibit varying widths across different oceans, with an average width of approximately 80 kilometres.



Statement-I is correct: Continental shelves are abundant in plankton, which serves as a primary food source for millions of surface and bottom-feeding fishes. As a result, **continental shelves are renowned as the richest fishing grounds in the world,** exemplified by locations such as the Grand Banks off Newfoundland, the North Sea, and the Sunda Shelf.

Statement II is correct: The Continental shelf is the extended margin of each continent occupied by relatively shallow seas and gulfs, meaning that they are **Seaward extensions of continental plates**. It is the **shallowest part of the ocean** showing an average gradient of 1° or even less. **This shallowness allows sunlight to penetrate** through the water, promoting the growth of minute plants and microscopic organisms like **plankton.** These **planktons serve as the primary food source for fishes,** contributing to the continental shelves being the richest fishing grounds. Hence the statement-II is correct and explains the statement-I.

55. Solution: (d)

Exp) Option d is the correct answer.

Ocean currents are large masses of surface water that circulate in regular patterns around the oceans. Warm currents come from the equator and move towards the poles, carrying warmer water. Cold currents come from polar regions and move towards the equator, carrying cooler water.

Option 1 is correct: The Earth's axial tilt towards the Sun affects the distribution of solar radiation, leading to **temperature** variations and driving the formation of ocean currents. Temperature differences between equatorial and polar waters cause **warm water to move slowly towards the poles,** while colder water flows along the sea bottom towards the equator. The Ocean current driven by this factor is the Gulf Stream, which flows from the equator towards the poles as warm current.

Option 2 is correct: The rotation of the Earth causes freely moving objects, including ocean currents, to be deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. This results in clockwise circulation patterns in the Northern Hemisphere, such as the **Gulf Stream Drift** and the Canaries Current,

and counterclockwise circulation patterns in the Southern Hemisphere, such as the Brazilian Current and the West Wind Drift.

Option 3 is correct: The location of Seas within the relatively enclosed spaces affects the flow of ocean current due to difference in the salinity. The salinity levels in ocean water vary across different locations. Water with higher salinity is denser than water with lower salinity. Consequently, less saline water tends to flow on the surface above more saline water. An illustration of this phenomenon can be observed in the Mediterranean region, where a significant salinity contrast exists between the open Atlantic and the partially enclosed Mediterranean Sea. The Atlantic's less saline water flows over the surface into the Mediterranean, and this is balanced by the outflow of denser bottom water from the Mediterranean.

Option 4 is correct: The direction of trade winds and seasonal winds plays a crucial role in driving surface ocean currents, as **wind stress causes water to move in the direction of the prevailing winds**. For example, **the North-East Trade Winds push the North Equatorial Current,** which then splits into various branches such as the Florida Current and the Gulf Stream Drift. Further the direction of ocean currents changes in response to shifts in wind patterns, such as during the **Southwest monsoon season.** This demonstrates the close relationship between wind patterns and ocean currents.

56. Solution: (b)

Exp) Option b is the correct answer.

Ocean water, like landmasses, varies in temperature across locations, with surface temperatures ranging from approximately 70°F in equatorial regions to about 55°F at latitudes 45°N and 45°S, and further decreasing towards the poles. However, this temperature variation is irregular due to factors such as ocean currents, winds, and air masses.

Option b is correct: Coastlines influenced by warm currents, like the **North Atlantic Drift**, witness a rise in surface temperatures. This warming effect explains why the **Norwegian coast, despite being, situated between latitudes 60° to 70°N, remains free of ice** throughout the year.

On the other hand, cold currents originating from the Arctic and Antarctic, such as the **Labrador Current off the northeastern Canada**, contribute to lowering surface-water temperatures. Consequently, ports along the **eastern coast of Canada, even at 45°N**, experience **ice formation** for a significant portion of the year.

57. Solution: (b)

Exp) Option b is the correct answer.

Corals are formed by multiple small, soft organisms known as polyps. They secrete a rocky chalk-like (calcium carbonate) exoskeleton around themselves for protection. Over many years, this process produces complex structures known as Coral reefs.

Statement 1 is correct: Corals require water temperatures above 20°C (68°F), which **confines their habitat mainly to tropical and subtropical zones**. However, warm currents, like the **Gulf Stream,** extend their range northward in the **Atlantic**, whereas the Pacific and Indian Oceans host the most coral reefs.

Statement 2 is correct: Corals thrive in shallow waters less than 100 feet deep, as sunlight is essential for the photosynthesis of microscopic algae upon which coral polyps depend. However, **depths exceeding 180 feet limit sunlight, hindering their survival**. Additionally, there **should always be ample water**, as coral polyps cannot survive for extended periods out of water.

Statements 3 is incorrect: Sediment-rich water poses a threat to coral survival as it can block sunlight, hindering photosynthesis essential for coral health. Additionally, sediments can physically damage coral tissues, compromise their ability to filter feed, and contribute to the proliferation of harmful microorganisms, leading to stress and mortality in coral reefs.

58. Solution: (c)

Exp) Option c is the correct answer.

Coastlines of emergence arise from either land uplift or sea level decline. They are relatively rare and are characterized by uplifted lowland coasts and emergent coastal plains. Due to their emergent nature, **they have fewer natural harbors and are not well suited for development of ports.**

Option a is incorrect: The irregular and indented coastline are more commonly associated with submergent coasts rather than emergent coasts. They are considered favorable for port development, because they offer various points for docking and berthing, increasing the ports' capacity and flexibility.

Option b is incorrect: Estuarine, ria, and fjord coasts are features commonly associated with submerged or drowned coasts, not emergent coasts. Also, they are generally favorable for port development due to their sheltered nature, ample depth, and relatively calm waters, which provide ideal conditions for harbor construction and navigation. Therefore, these types of coasts are typically sought after for port development.

Option c is correct: Raised beaches, steep cliffs, and extended continental shelves are all challenges for port development on emergent coasts. The continental shelf extends up to 500 km into the sea, which makes it difficult for the development of good ports and harbours. Further, the extended continental shelves result in shallow water near the shoreline, limiting vessels access and requiring extensive dredging for port development.

Option d is incorrect: Strong tidal currents and frequent storms are challenges for port development, but they are not exclusive to emergent coasts. These conditions can occur in various coastal environments, depending on factors such as geography, oceanography, and weather patterns.

Important Tips

Coastlines of submergence- It is formed due to the sinking of the land or the rise of the sea, including such coasts as Ria coasts, fiord coasts, estuarine coasts, and dalmatian or longitudinal coasts. It is well suited for the development of ports.

59. Solution: (d)

Exp) Option d is the correct answer.

Ocean waters absorb solar energy similar to land, but their heating and cooling occur at a slower rate. The distribution of ocean water temperature is influenced by factors such as latitude, the unequal distribution of land and water, prevailing winds, and ocean currents.

Statement I is incorrect: The average surface water temperature of the oceans is around 27°C, gradually decreasing from the equator toward the poles. However, the highest temperature is typically recorded slightly towards north of the equator (not towards the south of the equator), rather than directly at equator.

Statement II is correct: The unequal distribution of land and water influences ocean temperatures. Oceans in the Northern Hemisphere receive more heat due to their proximity to a larger landmass, resulting in relatively higher temperatures compared to the oceans in the Southern Hemisphere. The average annual temperatures for the northern and southern hemisphere are around 19° C and 16° C respectively.

Hence option d is correct: Statement I is incorrect, but Statement II is correct

60. Solution: (c)

Exp) Option c is the correct answer.

The horizontal and vertical motions are common in ocean water bodies. The horizontal motion refers to the ocean currents and waves. The vertical motion refers to tides.

Statement 1 is correct: Waves are actually the energy, not the water as such, which moves across the ocean surface. Water particles only travel in a small circle as a wave passes. Waves are created by energy passing through water, causing it to move in a circular motion. However, **water does not actually travel in waves.** If not obstructed by anything, waves have the potential to travel across an entire ocean basin.

Statement 2 is correct: Waves are most commonly caused by wind. Wind-driven waves, or surface waves, are created by the friction between wind and surface water. **Wind provides energy to the waves.** Waves continue to grow larger as they move and absorb energy from the wind. **Wind causes waves to travel in the ocean and the energy is released on shorelines.** When a breeze of two knots or less blows over calm water, small ripples form and grow as the wind speed increases until white caps appear in the breaking waves.

Statement 3 is incorrect: When the depth of water is less than half the wavelength of the wave, the wave breaks. The largest waves are found in the open oceans.

Statement 4 is correct: Waves travel because the wind pushes the water body in its course forming the crest of the wave and **gravity pulls the crests of the waves downward.** The falling water pushes the former troughs upward, and the wave moves to a new position.

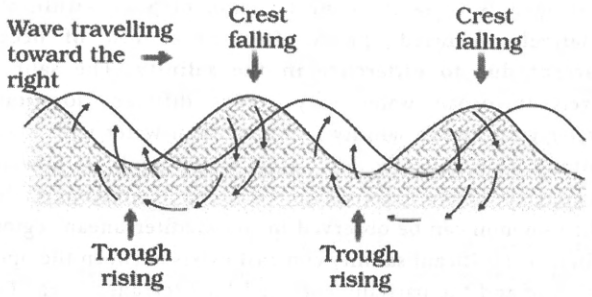


Figure13.1 : Motion of waves and water molecules

61. Solution: (d)

Exp) Option d is the correct answer.

The periodical rise and fall of the sea level, once or twice a day, mainly due to the attraction of the sun and the moon, is called a tide.

Option 1 is correct: The **centrifugal force of the Earth,** which is the force that **acts to counterbalance the gravity, plays an important role in the formation of tides.** Together, the gravitational pull and the centrifugal force are responsible for creating the two major tidal bulges on the Earth.

On the side of the earth facing the moon, a tidal bulge occurs due to gravitational attraction of the moon while on the opposite side though the gravitational attraction of the moon is less as it is farther away, the centrifugal force causes a tidal bulge on the other side.

Options 2 and 4 are correct: The **moon's gravitational pull to a great extent** and **to a lesser extent the sun's gravitational pull,** are the major causes for the occurrence of tides. Although the sun is 27 million times more massive than the moon, it is 390 times further away from the Earth than the moon. Therefore, the sun's tide-generating force is about half that of the moon, and the moon is the dominant force affecting the Earth's tides.

Option 3 is incorrect: The Coriolis force of the Earth is not responsible for the formation of tides. While the **Coriolis force can influence the direction and movement of tidal currents, it does not create the tides themselves.**

Coriolis force is the force caused by the rotation of the Earth. It is responsible for the deflection of wind towards the right in the northern hemisphere and the left in the southern hemisphere.

Important Tips

The 'tide-generating' force is the **difference between** these two forces; i.e. **the gravitational attraction of the moon and the centrifugal force.**

1. On the surface of the earth, nearest the moon, pull or the attractive force of the moon is greater than the centrifugal force, and so there is a net force causing a bulge towards the moon.

2. On the opposite side of the earth, the attractive force is less, as it is farther away from the moon, the centrifugal force is dominant. Hence, there is a net force away from the moon. It creates a second bulge away from the moon.

62. Solution: (a)

Exp) Option a is the correct answer.

Ocean currents are the continuous flow of huge amounts of water in a definite path and direction in the ocean.

Statement-I is correct: Near the equator, the ocean water is about 8 cm higher in level than in the middle latitudes. This causes a very slight gradient and water tends to flow down the slope. Gravity tends to pull the water down the pile and create gradient variation.

Statement-II is correct and is the correct explanation of Statement-I: The **equator receives more direct sunlight compared to the slanted rays experienced in middle latitudes** because of Earth's spherical shape. **Heating by higher solar energy causes the water to expand.** When water is heated, it expands, which is why **warmer water near the equator takes up more space than cooler water at higher latitudes.** Thus, thermal expansion of water causes the ocean water to be about 8 cm higher near the equator than in the middle latitudes.

63. Solution: (d)

Exp) Option d is the correct answer.

Ocean currents can also be classified based on temperature as cold currents and warm currents.

Options 1 and 4 are correct: Warm ocean currents bring warm water into cold water areas and are usually **observed on the east coast of continents in the low and middle latitudes.** This is true in both hemispheres. In the northern hemisphere, they are found **on the west coasts of continents in high latitudes.**

Options 2 and 3 are not correct: The cold ocean currents bring cold water into warm water areas. These currents are usually **found on the west coast of the continents in the low and middle latitudes** (true in both hemispheres) and on the **east coast in the higher latitudes in the Northern Hemisphere.**

64. Solution: (b)

Exp) Option b is the correct answer.

Ocean currents are the continuous, predictable, directional movement of seawater driven by gravity, wind (Coriolis Effect), and water density.

Row 1 is correct: The **Benguela** is a **cold ocean current** that flows along the **west coast of southern Africa.** Flowing along the coast of South Africa, Namibia, and Angola, the **Benguela Current is the eastern boundary of a large gyre in the South Atlantic Ocean.** The current mixes water from the Atlantic and Indian Oceans as they meet off the capes of South Africa.

Row 2 is correct: The **Agulhas** is a **warm ocean current** that flows along the **east coast of southern Africa.** It is the surface oceanic current that forms the western boundary current of the southern Indian Ocean. It flows southward along the southeast coast of Mozambique and the coast of South Africa before turning **eastward to join the flow from Africa to Australia.**

Row 3 is incorrect: The **Labrador** is a **cold ocean current** in the **North Atlantic Ocean that originates at the Davis Strait,** where it begins as a continuation of the West Greenland Current and the Baffin Island Current. From there, it flows southwards along the western side of the Labrador Sea. The current **passes along the coasts of Labrador, Newfoundland, and the east coast of Nova Scotia in Canada.** Labrador Current is a cold current with low salinity.

Row 4 is incorrect: The **Canary** is a **cold ocean current** that flows along the **west coast of northern Africa in the Atlantic Ocean.** It is part of a clockwise-setting ocean-current system in the North Atlantic Ocean. It branches south from the North Atlantic Current and flows south-westward along the northwest coast of Africa as far south as Senegal before turning westward to eventually join the Atlantic North Equatorial Current.

65. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: Ocean gyres are **vast systems of circulating ocean currents** that play a vital role in Earth's climate, oceanic ecosystems, and the distribution of marine debris.

1. They are **formed primarily** by the interaction of **global wind patterns, the Coriolis effect**, and the boundaries created by continents.

2. These gyres can span thousands of kilometers and are characterized by their rotational movement—clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere.

Statement 2 is incorrect: Most of the **world's major gyres are not located in the polar regions but in the subtropical regions.** These form between the polar and equatorial regions of Earth. There are five major oceanic gyres: the **North Atlantic, South Atlantic, North Pacific, South Pacific,** and **Indian Ocean gyres.** These are located in the **subtropical regions** and not the polar regions.

Statement 3 is incorrect: In reality, **western boundary currents within gyres are stronger and faster than eastern boundary currents.**

1. For example, the Gulf Stream in the North Atlantic Gyre is a strong, fast western boundary current, while the Canary Current is a slower eastern boundary current.
2. This intensification is due to the rotation of the Earth, which causes a phenomenon known as "**western intensification**," leading to stronger currents on the western side of ocean basins.

66. Solution: (b)

Exp) Option b is the correct answer.

Ocean currents closely influence the distribution of temperature, pressure, winds and precipitation, which directly or indirectly influence the economy and society of the people, especially those living in the coastal regions.

Statement 1 is incorrect: Warm currents flow parallel to the east coasts of the continents in tropical and subtropical latitudes. This **results in warm and rainy climates.** These areas lie in the western margins of the subtropical anti-cyclones.

On the other hand, the cold currents flow parallel to the west coasts in tropical and subtropical regions which cause the dry conditions.

Statement 2 is correct: Ocean currents influence trade. The **ports and harbours of higher latitudes which are affected by warm currents are ice-free** and open for trade all year round. For example, the **ports of North Western Europe remain open throughout the year** while the port of Quebec in Canada gets frozen in winter.

67. Solution: (b)

Exp) Option b is the correct answer.

Subsidence theory and Glacial control theory are related to the formation of coral reefs and atolls. The subsidence theory was postulated by Charles Darwin in 1837 and modified in 1842. According to this theory, **fringing reefs, barrier reefs, and atolls are successive stages of coral reef development** due to the **gradual subsidence of land.** Glacial control theory was proposed by Reginald Aldworth Daly. According to this theory, fluctuations of sea level during the building up and melting down of glaciers during the Pleistocene Epoch played a **major role in allowing coral to slowly build up structures.**

68. Solution: (a)

Exp) option a is the correct answer.

Downwelling is where surface water is forced downwards, where it may deliver oxygen to deeper water.

Statement 1 is correct: Regions of downwelling have **low productivity** because the nutrients get used up and are not continuously resupplied by the cold, nutrient-rich water from below the surface. Downwelling reduces biological productivity and transports heat, dissolved materials, and surface waters rich in dissolved oxygen to greater depths.

Statement 2 is correct: Ekman transport **helps in both upwelling and downwelling of water** in oceans. Where Ekman transport moves surface waters toward the coast, the water piles up and sinks in the process known as coastal downwelling. This example is from the Northern Hemisphere.

Statement 3 is incorrect: This is **not the impact of Downwelling** but rather what would happen if there were no Downwelling. A downwelling takes oxygen-rich surface water and flushes it through the deep sea. Without this renewal, the dissolved oxygen in bottom sediments and waters would quickly be used up by the decay of organic matter. **Anaerobic bacteria** would take over decomposition, **leading to a buildup of hydrogen sulfide.** Only a few benthic animals would survive such toxic conditions.

69. Solution: (d)

Exp) Option d is the correct answer.

Ocean currents have a number of direct and indirect influences on human activities -

1. West coasts of the continents in tropical and subtropical latitudes are bordered by cool waters. **Cold ocean currents have a direct effect on desert formation in west coast regions of the tropical** and sub-tropical continents.
2. Warm ocean currents bring rain to coastal areas and even interiors. Example: The **North Atlantic Drift keeps the coasts of the North Sea warm** which is unusual for such high latitudes.
3. Warm currents flow parallel to the east coasts of the continents in tropical and subtropical latitudes. This results in warm and rainy climates. These areas lie in the western margins of the subtropical anti-cyclones.
4. They are responsible for moderate temperatures at coasts. Ex: **Canary cold current brings cooling effect to Spain, Portugal etc.**
5. The mixing of warm and cold currents helps to **replenish the oxygen and favour the growth of planktons,** the primary food for fish population.

70. Solution: (b)

Exp) Option b is the correct answer.

An Estuary is a semi enclosed coastal body of water with one or more rivers or streams flowing into it. Features of estuaries are:

Statement 1 is incorrect - Estuarine **environments are among the most productive on earth, creating more organic matter each year** than comparably sized areas of forest, grassland or agricultural land. The sheltered waters of estuaries also support unique communities of plants and animals specially adapted for life at the margin of the sea. Thousands of species of birds, mammals, fish and other wildlife depend on estuarine habitats as places to live, feed and reproduce. And many marine organisms, including most commercially important species of fish, depend on estuaries at some point during their development.

Statement 2 is correct - An **estuary is a partially enclosed body of water along the coast where freshwater from rivers and streams meets and mixes with salt water from the ocean. It is an ecotone zone** between river environments and maritime environments. Estuaries and the lands surrounding them are places of transition from land to sea and freshwater to salt water.

71. Solution: (b)

Exp) Option b is the correct answer.

Atlantic Meridional Overturning Circulation (AMOC) is a part of the global ocean conveyor belt (THC) that works to distribute nutrients and heat all over the globe.

Statement 1 is correct: Atlantic Meridional Overturning Circulation (AMOC) is a Thermo-Haline circulation (THC) -i.e., **movement of ocean water driven by differences in densities due to salinity and temperature**, in the Atlantic Ocean.

Statement 2 is correct: AMOC carries **warm surface waters from the tropics northwards in Atlantic Ocean**, where it cools and sinks. It then returns to the tropics and then to the South Atlantic as a bottom current. From there it is distributed to all ocean basins via the Antarctic circumpolar current.

Statement 3 is incorrect: IPCC's Assessment Report 6 (AR6) as well as recent papers in Nature Climate Change, indicate that **due to anthropogenic climate change, the AMOC is slowing down** to unprecedented levels in a millennium. Global warming is causing **melting** of even the deepest and most untouched **ice shelves in the Arctic** from an area called "The Last Ice Area". The freshwater from the melting ice **reduces the salinity and density of the water.** Now, the water is unable to sink as it used to, and **this weakens the AMOC flow.**

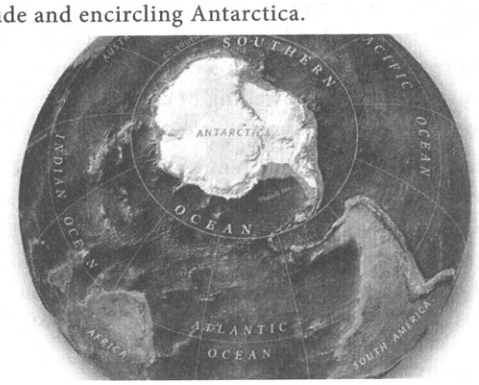
Statement 4 is correct: The **weakening of** the Atlantic Meridional Overturning Circulation **(AMOC) could result in more storms** in the **UK**, more **intense winters and an increase in damaging heatwaves and droughts across Europe.**

72. Solution: (d)

Exp) Option d is the correct answer.

The Southern Ocean, also known as the Antarctic Ocean, is the **fourth-largest ocean on Earth** and surrounds Antarctica. It is the body of water surrounding Antarctica and extending to the **southernmost tip of South America, Africa, and Australia**. It is known for its **strong winds and currents, as well as its cold temperatures and high levels of salinity**. The Southern Ocean is also home to a diverse array of marine life, including penguins, seals, and whales.

Statement 1 is correct: The Southern Ocean is the **only ocean that completely encircles our planet**, uninterrupted by any significant land mass. It comprises the southernmost waters of the world ocean, generally taken to be south of 60° S latitude and encircling Antarctica.



Southern Ocean

Statement 2 is correct: The Southern Ocean has **no clear northern boundary**, as it is **fed by water from the other oceans.** The currents that flow into the Southern Ocean from the other oceans help to mix the water and create the unique oceanography of the Southern Ocean.

Statement 3 is correct: The Southern Ocean is known for its high albedo capacity. **The Southern Ocean is known as the "Global sink"** as it plays a vital role in absorbing and storing carbon from the atmosphere, which helps to mitigate the impacts of climate change.

73. Solution: (a)

Exp) Option a is the correct answer.

Options 1, 2 and 3 are correct. Coral reefs ideally require sunlight, clean water to sunlight through, Salt water, and abundant Planktons. In India, the major reef formations are found in the **Gulf of Mannar**, Palk bay, **Gulf of Kutch**, Andaman and Nicobar Islands and the **Lakshadweep islands.**

Option 4 is incorrect. Due to the presence of high volume of freshwater, **coral reefs are not formed in Sunderbans.**

74. Solution: (b)

Exp) Option b is the correct answer.

There are two equatorial currents flowing from east to west - the North equatorial current and South equatorial current. In between the two, there flows an equatorial counter current in the opposite direction, **i.e from west to east**. Example: Piling up of waters in the area near Brazil, **due to convergence of the two equatorial currents give rise to the equatorial counter current.**

Equatorial counter-currents are major surface flows that carry water eastward in the Atlantic, Indian, and Pacific Oceans. They are located near the equator and are sandwiched between two westward-flowing currents, the North Equatorial Current and the South Equatorial Current. Equatorial counter-currents are unique, in that they flow in the opposite direction of the surface winds.

75. Solution: (d)

Exp) Option d is the correct answer.

Ocean currents are the continuous, predictable, directional movement of seawater. It is driven by factors like gravity, wind (Coriolis Effect), and water density.

Statement 1 is correct. Ocean currents are generally referred to by their "drift". Ocean currents are stronger at the surface and may attain speeds over 5 knots. At depths, currents are generally slow with speed less than 0.5 knots.

Statement 2 is correct. Rotation of Earth leads to Coriolis effect which influences direction of ocean currents. The Coriolis effect causes air and water to move towards the right in the northern hemisphere and the left in the southern hemisphere.

Statement 3 is correct. Differences in water density affect the mobility and speed of ocean currents. Denser water tends to sink whereas lighter water tends to rise. Cold-water ocean currents occur when the cold water at the poles sinks and

slowly moves towards the equator. Warm-water currents travel out from the equator along the surface, flowing towards the poles to replace the sinking cold water.

76. Solution: (d)

Exp) Option d is the correct answer.

Thermohaline circulation is an oceanographic phenomenon which drives a global-scale system of currents. Thus, it is can be said to be the "global conveyor belt".

There is constant motion in the ocean in the form of a global ocean conveyor belt. This motion is caused by a combination of thermohaline currents in the **deep ocean and wind-driven currents on the surface.** Cold, salty water is dense and sinks to the bottom of the ocean while warm water is less dense and remains on the surface.

In this, the upper part of the Atlantic thermohaline circulation carries warm, upper ocean water through the tropics and subtropics toward the north pole while the deep part carries cold, dense polar water move southward through the Atlantic, around the tip of Africa, and into the ocean beyond.

77. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is incorrect. Indian ocean has the Ninety East Ridge which extends from continental shelf of Irrawaddy River mouth. It runs almost North-South direction parallel to 90-degree North longitude up to 40-degree South where it merges with Amsterdam-St Paul Plateau.

Central Ridges or Mid Oceanic Ridge in Indian Ocean which is known as Mid Indian Oceanic Ridges extends from Southern tip of Indian Peninsula in the North to Arctica in the South almost in North-South direction and forms a continuous chain of highlands.

Statement 2 correct. The **New Caledonia Barrier Reef which is located in the South Pacific is one of the longest reefs in the world,** covering a length of 930 miles. It is a home to more than 1000 different species-- some of which are still unclassified which live within the reef.

Statement 3 is correct. Pacific continental shelf of South America is represents the example of narrow shelf (16km). The Atlantic continental shelf off the east coast of North America represents the example of medium size shelves (96-120km) and extensive shelves having width of a few hundred kilometres are found off the coast of in Arctic Sea, Arafura Sea, China Sea Adriatic Sea etc. **The world's largest continental shelf extends 1,500 km (about 930 miles) from the coast of Siberia into the Arctic Ocean.**

Statement 4 is incorrect. The **Pacific Ocean does have oceanic ridges. Pacific-Antarctic Ridge (PAR) is a divergent tectonic plate boundary located on the seafloor of the South Pacific Ocean.** Also, the east pacific ridge known as Albatross Plateau is 1600 km wide and it extends from the North of New Zealand to the California,

78. Solution: (c)

Exp) Option c is the correct answer.

When trade winds move over warm tropical waters, they pick up moisture and bring heavy rainfall to the windward facing slopes of mountainous areas, contrasting with the downward motion of dry air that creates desert areas on land.

Statement 1 is correct. Warmer water is transported westward in the ocean by the Northeast trade winds in the Northern hemisphere of the tropical zone (as the figure given below shows). So, in tropical zones, the western section of ocean is warmer than eastern sections due to trade winds.

Statement 2 is correct. Westerlies play an important role in carrying the warm, equatorial waters and winds to the western coasts of continents (that is eastern section of the Oceans in temperate zone). Thus, in temperate zones, westerlies make the eastern section of the ocean warmer than the western

sections.

79. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. The size of the oceans and the seas affects annual range of temperature e.g., **bigger the size, lower the annual range and vice versa**. The **Atlantic Ocean records relatively higher annual range of temperature than the Pacific Ocean due to this reason.**

Statement 2 is correct. The temperature of ocean water varies in the northern and the southern hemispheres because of dominance of land in the former and water in the latter. The **oceans in the northern hemisphere receive more heat due to their contact with larger extent of land than their counterparts** in the southern hemisphere and thus the temperature of surface water is comparatively higher in the former than the latter.

Other factors affecting the distribution of temperature of ocean water include:

- **Latitudes:** The temperature of surface water decreases from equator towards the poles because the sun's rays become more and more slanting and thus the amount of insolation decreases poleward accordingly.
- **Prevailing wind**: Wind direction largely affects the distribution of temperature of ocean water. The winds blowing from the land towards the oceans and seas (e.g., offshore winds) drive warm surface water away from the coast resulting into upwelling of cold bottom water from below.
- **Ocean currents**: Surface temperatures of the oceans are controlled by warm and cold currents. Warm currents raise the temperature of the affected areas whereas cool currents lower down the temperature. For example, the Gulf Stream raises the temperature near the eastern coasts of N. America and the western coasts of Europe

80. Solution: (a)

Exp) Option a is the correct answer.

In the Pacific Ocean, near Hokkaido, Japan the colder **Oyashio Current converges from the north with the warmer Kuroshio Current, which flows from the south.**

The Kuroshio and Oyashio Currents **are the western boundary currents** in the wind-driven, subtropical and subarctic circulations of the North Pacific Ocean.

The subarctic North Pacific Ocean, on the other hand, is dominated by upwelling. The **upwelled, nutrient-rich water feeds the Oyashio** from the north.

The confluence of these currents is marked by fogbanks and have great influence on fisheries and climate in the western North Pacific.

GENERAL GEOGRAPHY

CLIMATOLOGY

4.1. Structure and Composition of Atmosphere

1. Consider the following statements:

Statement I: The troposphere is thickest at the equator and comparatively thinner at the Poles.

Statement II: Heat difference on Earth's surface causes the convectional currents to rise at greater heights at warmer places.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

2. With reference to the troposphere, consider the following statements:

1. The majority of the mass of the entire atmosphere is contained in this layer.
2. It is always calm with little turbulence.
3. Most of the Earth's clouds are located in this layer.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 3 only
(c) 2 only
(d) 2 and 3 only

3. Consider the following statements regarding the Ozone Layer present in the atmosphere:

1. The Ozone layer is almost transparent to most of the Ultraviolet-A (UV-A) type of radiation.
2. Carbon Tetrachloride is one of the Ozone layer depleting substances.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

4. Consider the following statements regarding the Ionosphere, present in the atmosphere:

1. Many of the low-Earth orbiting satellites are located in the ionosphere.
2. In this layer, the temperature starts decreasing with increasing height.
3. Radio waves transmitted from the Earth are reflected back to the Earth by this layer of atmosphere.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

5. Higher concentration of dust particles is found in subtropical and temperate regions as compared to equatorial and polar regions. The most appropriate reason for this is:

(a) Anti-cyclonic conditions in subtropical high-pressure belts
(b) Presence of belt of strong upper-level wind circulation
(c) Presence of drier winds in the region
(d) Higher elevation of continental landmass in the region

6. With reference to 'Water Vapour in atmosphere', consider the following statements:

1. It is responsible for about half of Earth's greenhouse effect.
2. The amount of water vapour generally decreases from the equator towards the poles.
3. It redistributes heat energy on the Earth through latent heat energy exchange.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

7. Consider the following:

1. Evaporation
2. Precipitation
3. Hydration
4. Transpiration
5. Condensation

How many of the above are part of the hydrological cycle?

(a) Only two
(b) Only three
(c) Only four
(d) All five

8. Consider the following pairs:

Atmospheric Layers	Features
1. Stratosphere	Nearly free from clouds and weather phenomena
2. Thermosphere	Temperature increases with altitude
3. Mesosphere	Aurora borealis is observed here

How many pairs given above are correctly matched?

(a) None
(b) Only one
(c) Only two
(d) All three

9. 'Milankovitch oscillations' primarily deals with which of the following?

(a) Rapid shift in the atmospheric pressure patterns in equatorial regions.
(b) Changes in the composition of the Earth's interior.
(c) Changes in the Earth's climate over a long period of time.
(d) Variations in the density of the ozone layer over a region.

10. Consider the following gases:

1. Nitrous Oxide
2. Hydrofluorocarbons
3. Hydrochlorofluorocarbons
4. Carbon Monoxide
5. Argon
6. Tropospheric ozone

How many of the above gases are considered as potential greenhouse gases?

(a) Only two
(b) Only three
(c) Only four
(d) Only five

11. Consider the following statements regarding the depletion of the stratospheric ozone layer:

1. The ozone concentration of less than 220 Dobson units signifies an ozone hole in the atmosphere.
2. The Polar Stratospheric Clouds (PSCs) over Antarctica intensify the depletion of the ozone layer in the region.
3. The emissions of hydrofluorocarbons in the atmosphere directly contribute to the depletion of the ozone layer.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

12. Consider the following impacts:

1. Photosynthesis would become impossible.
2. Extra-terrestrial objects like meteors would reach earth unburnt.
3. Cataracts in eyes.
4. Disruption in the marine food chain.

How many of the above will be the impacts/ results of the absence of the ozone in the atmosphere?

(a) Only one
(b) Only two
(c) Only three
(d) All four

13. Consider the following statements:

Statement I: Carbon Dioxide is categorized as a Green House gas.

Statement II: Carbon dioxide absorbs the terrestrial solar radiation and re-emits it in all directions.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

14. With reference to the different layers of the atmosphere, consider the following statements:

1. The thickness of the troposphere is greater near the equator compared to polar regions.
2. The Stratosphere has larger amounts of water vapor compared to any other layer of the atmosphere.
3. The mesosphere is the coldest layer of the atmosphere.
4. Radio waves transmitted from the earth are reflected to the surface by the Ionosphere.

How many of the statements given above are correct?

(a) 1 and 4 only
(b) 1, 2 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

15. Consider the following information:

Atmospheric Layer	Temperature in the layer	Significance
1. Stratosphere	Increases with increase in altitude	Ozone Layer is located in this layer.
2. Mesosphere	Decreases with increase in altitude	International Space station orbits around the earth in this layer.
3. Ionosphere	Decreases with increase in altitude	Radio waves transmitted from the Earth are reflected back to Earth by this layer.

In how many of the above rows is the given information correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

16. With reference to the presence of water vapour in Earth's atmosphere, which of the following statements is/are correct?

1. The volume of water vapour in the atmosphere generally decreases as we move from the equator towards the poles.
2. Water vapour absorbs both insolation coming from the sun as well as terrestrial radiation emitted by the Earth's surface.
3. It is the most abundant greenhouse gas on Earth.

Select the correct answer using the code given below:

(a) 1 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

17. In Earth's atmosphere, the temperature change with rise in altitude varies across different layers. In some layers, the temperature decreases with increase in altitude, while in others, it increases. In this context, consider the following layers of the atmosphere:

1. Troposphere
2. Stratosphere
3. Mesosphere
4. Thermosphere

In which of the above layers does the temperature generally decrease with increase in altitude?

(a) 1 and 3 only
(b) 2 and 4 only
(c) 1, 2 and 3
(d) 1, 3 and 4

18. Nitrogen and Oxygen are the two most prominent gases in Earth's Atmosphere. Out of the remaining, arrange the following gases in decreasing order of their volume in the atmosphere.

1. Hydrogen
2. Carbon Dioxide
3. Helium
4. Argon

Select the correct answer using the code given below

(a) 2-1-3-4
(b) 4-2-3-1
(c) 2-4-3-1
(d) 4-2-1-3

19. Which of the following is the primary feature of the Earth's atmosphere, that protects us from meteoroids?

(a) Absorption of energy by stratosphere
(b) Presence of high-energy radiation in ionosphere
(c) Existence of ozone layer all over the planet
(d) Presence of mesosphere

4.2. Temperature Distribution and Heat Budget

20. Consider the following statements about the effects of temperature inversion on the local weather:

1. It causes atmospheric stability in the lower layers of atmosphere by limiting the vertical movement of air.
2. It makes conditions suitable for the formation of dense fog.
3. Temperature inversion in hills and mountains helps to protect plants from frost damage.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

21. The term 'Heat Island' is often seen in the news. In this context, consider the following statements regarding the Heat Island:

1. Calm and clear weather conditions can result in severe heat islands.
2. Strong winds and cloud cover enhances the formation of heat islands.
3. The low albedo value of concrete surfaces helps in the formation of Heat Islands.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 2 only

22. Consider the following statements:

1. Earth absorbs only the long-wave radiation coming from the Sun.
2. Out of total radiation coming to Earth from the sun, more than 50% is reflected back to space by clouds.

Which of the statements given above is/are **incorrect**?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

23. With reference to 'Solar Radiation on Earth', consider the following statements:

1. The surface of Earth receives most of its energy in long ultraviolet wavelength.
2. The angle of inclination of the rays of sun influences the amount of insolation received at different latitudes.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

24. Arrange the following surfaces in increasing order of their albedo:

1. Fresh snow
2. Sand
3. Grass
4. Thin Cloud

Select the correct answer using the code given below:

(a) 3-4-2-1
(b) 3-2-4-1
(c) 2-3-4-1
(d) 2-3-1-4

25. With reference to 'Spatial Distribution of Insolation at the earth's surface', consider the following statements:

1. The subtropical deserts receive maximum insolation on Earth.
2. The amount of insolation received by the equator is more as compared to the tropics.
3. The middle and higher latitudes receive less insolation in the winter season than in the summer.
4. At the equinoxes, the solar insolation is zero at the poles.

Which of the following statements given above are correct?

(a) 1 and 4 only
(b) 2 and 3 only
(c) 1, 3 and 4 only
(d) 3 and 4 only

26. With reference to Isotherms, consider the following statements:

1. These are imaginary lines connecting the places with the same temperatures.
2. These lines are generally parallel to the lines of longitude.
3. Closely spaced isotherms indicate very gradual variation in temperature.

Which of the statements given above is/ are correct?

(a) 1 and 3 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 only

27. With reference to the likely effects of the Inversion of Temperature, consider the following:

1. Suppression of rainfall.
2. Poor air quality in winter months.
3. Shifting of human settlements to mountain tops from the mountain valleys.
4. Thriving vegetation in the Valley regions.

Which of the options given above are correct?

(a) 1, 2 and 3 only
(b) 1 and 4 only
(c) 2 and 3 only
(d) 1, 2, 3 and 4

28. In Northern India during summer season, local winds called 'loo' can be observed to be blown. This wind is mainly the outcome of which one of the following processes?

(a) Conduction
(b) Radiation
(c) Advection
(d) Convection

29. With reference to the temperature of Earth, consider the following statements:

1. The shape of the Earth affects the amount of heat received in different places on Earth.
2. Temperature generally increases with increasing altitude.
3. The variation in temperature over the sea is more compared to land.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

30. With reference to Heat Budget of the Earth, consider the following statements:

1. Terrestrial radiation is responsible for heating the lower atmosphere of Earth.
2. More than 50 percent of the incoming solar radiation is absorbed by Earth's atmosphere.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

31. Consider the following statements:

Statement I: During winters, the isotherms shift towards the south over the continents and towards the north over the oceans in the Northern hemisphere.

Statement II: Land has lower thermal capacity and limited heat transfer capacity than water.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct

32. Consider the following conditions:

1. Long winter nights
2. Cloudless and clear sky
3. Low Pressure weather system
4. Dry air near the ground surface

How many of the above are the favorable conditions for the meteorological phenomenon of temperature inversion?

(a) Only one
(b) Only two
(c) Only three
(d) All four

33. Consider the following factors:

1. Rotation of the Earth on its axis
2. Length of the Day
3. Ocean Currents
4. Transparency of the atmosphere
5. Orientation of the land

How many of the above factors directly influence the amount of insolation received on the Earth's surface?

(a) Only two
(b) Only three
(c) Only four
(d) All five

34. With reference to the impact of water bodies on the climate of a region, consider the following statements:

Statement-I: The presence of large and deep lakes exercises a significant effect in moderating the climate of a surrounding land region.

Statement-II: The specific heat of water is more than that of land surface.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

35. With reference to the Normal Lapse Rate in the Troposphere, consider the following statements:

At a particular location the Normal Lapse Rate,

1. is usually higher in the summer season as compared to the winter.
2. is usually higher in the daytime as compared to the nights.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

36. Consider the following statements:

Statement-I: The diurnal range of temperature in the hot deserts is very high.

Statement-II: Clear, cloudless skies are typical features of hot deserts.

Statement-III: Dry air on land warms and cools more quickly.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-II and Statement-III are correct, and both of them explain Statement-I.
(b) Both Statement-II and Statement-III are correct, but only one of them explains Statement-I.
(c) Only one of the Statement-II and Statement-III is correct and that explains the Statement-I.
(d) Neither Statement-II nor Statement-III is correct.

37. With reference to the heating effect of the Sun, consider the following statements:

Statement I: For a given amount of solar irradiation, landmasses get heated up more quickly than the oceans.

Statement II: Land is more opaque to solar radiation as compared to water.

Statements III: Land has a much higher specific heat capacity than water.

Which one of the following is correct in respect of the statements given above?

(a) Both statement -II and statement -III are correct and both of them explain statement -I.
(b) Both statement -II and statement -III are correct, but only one of them explains statement -I.
(c) Only one of the statements II and III is correct, and that explains statement -I.
(d) Neither Statement -II nor statement -III is correct.

38. Consider the following statements :

Statement-I: Earth's overall temperature remains relatively stable over longer periods.

Statement-II: The amount of heat received by the earth in the form of insolation will be equal to the amount of heat lost by the earth through terrestrial radiation.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-l is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

39. Consider the following statements related to winter months in the Northern hemisphere of the Earth:

Statement-I: During this period there is a decrease in temperature compared to summers.

Statement-II: During this period the inclination of the northern hemisphere of the earth is away from the sun.

Statement-III: During this period the northern hemisphere of the earth is at the aphelion position.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-II and Statement-III are correct and both of them explain Statement-I
(b) Both Statement-II and Statement-III are correct but only one of them explains Statement-I
(c) Only one of the Statement-II and Statement-III is correct and that explains Statement-I
(d) Neither Statement-II nor Statement-III is correct

40. Consider the following statements with reference to the spatial distribution of insolation across the Earth:

1. The total amount of insolation received at the equator is roughly about 100 times of that received at the poles.
2. At the same latitudes, generally the insolation is greater over the land than over the ocean.
3. The sub-tropical high-pressure belt zone receives very low insolation due to the presence of dense clouds.

Which of the statements given above is/are correct?
(a) 1 and 2
(b) 2 only
(c) 3 only
(d) 2 and 3

41. Consider the following factors:

1. Distance from the sea
2. Latitude
3. Altitude
4. Longitude

How many of the above factors directly influence the temperature of a place?
(a) Only one
(b) Only two
(c) Only three
(d) All four

42. Consider the following statements:

Statement-I: The land heats up and cools down much faster than oceans.

Statement-II: The specific heat of land is more than that of water.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I.
(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect, but Statement-II is correct.

43. Consider the following statements:

Statement I: In polar areas, temperature inversion is common throughout the year.

Statement II: In polar regions, persistent cold and minimal solar heating keep the ground surface cooler than the air above.

Which of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I
(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I
(c) Statement-I is correct, but Statement-II is incorrect
(d) Statement-I is incorrect, but Statement-II is correct

44. Which among the following surfaces has the highest albedo?

(a) Grasslands
(b) Water
(c) Sand
(d) Snow

45. Consider the following statements:

Statement I: Earth's temperature remains stable over long periods of time.

Statement II: The oceans absorb most of the excess heat from greenhouse gas emissions.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

46. With reference to the mechanisms of heat transfer in Earth's atmosphere, consider the following statements:

1. Advection is the main mechanism of heat redistribution in the middle latitudes.
2. Convective transfer of heat energy is confined only to the troposphere.

Which of the statements given above is/ are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

47. Which among the following cities has the longest day in the month of December?
(a) Paramaribo
(b) San Salvador
(c) Lisbon
(d) Malta

4.3. Pressure Belts and Systems

48. Consider the following statements about Katabatic winds, in the context of mountain and valley winds:
1. It is a warm wind that blows up a mountain slope due to a warmer temperature on the mountain slope.
2. The Bora winds of Adriatic and Oroshi winds of Japan are examples of katabatic winds.
3. They can sometimes lead to the formation of Antarctic Oases.

Which of the statements given above is/are correct:
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

49. Which of the following statements correctly describes Ferrell's Law?
(a) It describes the movement of cold ocean currents near the coasts providing relief to people.
(b) It states that any object in the northern hemisphere will deflect to its right due to earth's rotation.
(c) It describes the interval of the occurrence of La Nina and El Nino in the Indian Ocean.
(d) It shows the relationship between planet's distance from sun and amount of time it takes to revolve around the sun.

50. With reference to the velocity and direction of wind, consider the following statements:
1. The speed of the wind is directly proportional to the pressure gradient force.
2. The friction force on the wind is more at the land surface than on the sea surface.
3. The rotation of Earth on its axis causes a change in wind's direction.

Which of the statements given above are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

51. Which one of the following statements is incorrect about the Sub-Tropical High-Pressure belt?
(a) It is formed due to subsidence of air coming from the equatorial region.
(b) Many of the world's deserts are present along this belt.
(c) This belt is also known as the 'Doldrums'.
(d) It is characterized by anticyclonic conditions with calm and arid weather.

52. Consider the following paragraph:

"When an air parcel remains over a homogenous area for a sufficiently longer time, it acquires the characteristics of the area. The homogenous area can be the vast ocean surface or vast plains. This air parcel has distinctive characteristics in terms of temperature and humidity. It is defined as a large body of air having little horizontal variation in temperature and moisture. The homogenous surfaces, over which it is formed, are called the source regions".

About which phenomenon the above paragraph is talking about?
(a) Local winds
(b) Jet streams
(c) Fronts
(d) Air Masses

53. Consider the following statements about the Inter-Tropical Convergence Zone (ITCZ):
1. It is formed due to the convergence of trade winds from the southern and northern hemispheres.
2. High incidence of thunderstorms is an important feature of the ITCZ.

Which of the above given statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

54. "It is a violently rotating column of air touching the ground. It is attached to and extends from the base of a thunderstorm.

It generally develops extremely rapidly, and also dissipates quickly. It is capable of completely destroying well-made structures and uprooting trees. It is also known as Twister."

Which of the following atmospheric phenomena is being described in the above paragraph?

(a) Blizzard
(b) Air Mass
(c) Tornadoes
(d) Downbursts

55. Which of the following winds blow over or around the Mediterranean Sea region?

1. Sirocco
2. Nor wester
3. Bora
4. Santa Ana
5. Mistral

Select the correct answer using the code given below:

(a) 2 and 4 only
(b) 1, and 5 only
(c) 1, 3 and 5 only
(d) 1, 2, 3, 4 and 5

56. With reference to the Earth's Rossby Waves, consider the following statements:

1. The equatorial Rossby waves can result in formation of twin cyclones.
2. The Rossby waves transfer heat from the tropics toward the poles.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

57. With reference to Planetary Winds and their associated regions, consider the following statements:

1. The Westerlies originate in the sub-tropical high-pressure belt and blow towards poles.
2. The Westerlies result in heavy precipitation and strong winds at horse latitudes.
3. The Westerlies of the Southern hemisphere are more robust and constant than the westerlies of the Northern hemisphere.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

58. With reference to Polar Vortex, consider the following statements:

1. It is a whirling cone of high pressure over the poles.
2. When the vortex becomes strong, a wave of cold air is always pushed southwards.
3. The term vortex refers to counterclockwise flow of air.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 3 only
(d) 2 and 3 only

59. Which of the following statements are correct about the 'Chinook Winds'?

1. These are warm and dry winds that usually blow in Winter Season.
2. They blow along the eastern slopes of the Rocky Mountains.
3. These winds are useful for the ripening of grapes.

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

60. With reference to the Coriolis Force, consider the following statements:

1. It is responsible for the deflections in the direction of Winds.
2. It acts perpendicular to the direction of velocity of the object.
3. Coriolis Force is higher at the Poles, than at the Equator.
4. The latitude is the sole factor influencing its strength.

Which of the statements given above are correct?

(a) 1, 2 and 3 only
(b) 2 and 4 only
(c) 1 and 3 only
(d) 1, 2, 3 and 4

61. With respect to the Air Masses, consider the following statements:

1. They are very small packets of atmospheric air showing great changes in temperature and moisture.
2. They are formed when wind speeds are sufficiently low.
3. They do not form over oceans and can be formed over lands only.
4. They often bring changes in the weather conditions.

Which of the statements given above are correct?

(a) 1, 2 and 4 only
(b) 2 and 4 only
(c) 1 and 4 only
(d) 2 and 3 only

62. With reference to the characteristics of Mountain and Valley breezes, consider the following statements:

Statement-I: Mountain breezes are slightly warmer than the Valley breezes.

Statement-II: Mountain breeze occurs at night, whereas Valley breeze occurs during the day.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

63. Which one of the following best describes the meaning of "geostrophic winds"?

(a) Winds blowing from high to low pressure areas.
(b) Winds blowing parallel to regions having the same pressure.
(c) Winds blowing perpendicular to regions having the same pressure.
(d) Winds blowing in a circular path around a low-pressure area.

64. With reference to the global atmospheric circulation, the term 'Ferrel cell' refers to:

(a) the zone of high pressure situated at the poles, impacting worldwide wind patterns.
(b) the belt of prevailing winds that blow from west to east in the tropics.
(c) the large-scale atmospheric circulation cell located at the equator.
(d) the zone of low pressure within the mid latitude characterised by converging winds.

65. Consider the following factors:

1. Presence of Strong convective current in the Equatorial region.
2. Influence of Coriolis force on the direction of winds from Tropical Region
3. High Incoming Solar Radiation in the Equatorial region.

How many of the above factors are responsible for the presence of low pressure in the equatorial region?

(a) Only one
(b) Only two
(c) All three
(d) None

66. Consider the following statements:

Statement I: We generally do not experience strong upward pressure despite the vertical pressure gradient force being significantly greater than the horizontal pressure gradient in the atmosphere.

Statement-II: The vertical pressure gradient force in the atmosphere is generally balanced by a nearly equal but opposite gravitational force of the Earth.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

67. Consider the following statements regarding the Inter Tropical Convergence Zone (ITCZ):

1. It remains confined between 0-5 degrees North and South of Equator throughout the year.
2. It represents a high-pressure zone.
3. It is essentially devoid of any rainfall activity.

Which of the above given statements is/are **incorrect?**
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

68. With reference to the local wind called 'Loo', consider the following statements:
1. These are hot and dry winds blowing during the summer season over north and northwestern India.
2. Its formation is mainly attributed to vertical movement of wind through the convection process.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

69. Which of the following is incorrect with respect to the Ekman Spiral?
(a) It is a combined result of the friction force of wind and Coriolis force on the ocean water.
(b) It ceases to operate in ocean water at depths of more than 100 metres.
(c) It has reduced action of wind with increasing depth of ocean water.
(d) It necessarily results in the increased biological activity in the area of its occurrence.

70. With reference to Jet streams, consider the following statements:
1. They generally flow from east towards west.
2. The location of Easterly jet stream plays a significant role in the distribution of monsoon rainfall over the Indian subcontinent.

Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

71. Local winds over a region develop due to local differences in temperature and pressure and can be classified as hot and cold winds. In this context, consider the following
1. Foehn
2. Chinook
3. Blizzard
4. Mistral
5. Zonda
6. Buran

How many of the above local winds are cold winds?
(a) Only two
(b) Only three
(c) Only four
(d) Only five

72. With reference to the Global atmospheric circulation, consider the following statements:
1. Doldrums are characterized by windless conditions formed near the equator.
2. Horse latitude represents a region marked by gentle winds, clear skies and little precipitation.
3. Temperate low-pressure belts are a region characterized by absence of any cyclonic activity.

Which of the statements given above is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

73. Consider the following statements regarding the movement of winds in an anti-cyclonic condition:

Statement-I: Winds in an anti-cyclonic condition blow clockwise in the Northern Hemisphere and anti-clockwise in the Southern Hemisphere.

Statement-II: The Coriolis effect deflects winds to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

74. "These are strong, dry, and warm winds that originate from high-pressure areas over inland desert region and move

toward coastal area. These winds are most common during autumn and early winter. These winds play a role in spreading wildfires rapidly, particularly in Southern California."

Which of the following winds is described in the above paragraph?

(a) Chinook
(b) Santa Ana
(c) Harmattan
(d) Foehn

75. With reference to weather phenomenon, consider the following statements about Air masses:

1. It is a large body of air with uniform horizontal temperature and humidity for hundreds of kilometers.
2. They are primarily formed in the region with strong atmospheric activities like cyclones and frontal zones.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

76. In the context of Polar Vortex, consider the following statements:

Statement I: It generally strengthens in winters and weakens in summers

Statement II: In the polar region, the temperature gradient is higher in winter than in summer.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation for Statement I
(b) Both Statement I and Statement II are correct and Statement II is not the correct explanation for Statement I
(c) Statement I is correct, but Statement II is incorrect
(d) Statement I is incorrect, but Statement II is correc

77. Consider the following statements:

Statement I: Anabatic winds are downslope winds that occur at night in hilly and mountainous regions.

Statement II: At night, the cooling of air on slopes in hilly areas causes it to become denser and flow downwards into the valleys.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II does not explain Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

78. Consider the following Pressure belts:

1. Subtropical High-Pressure Belts
2. Subpolar Low-Pressure Belts
3. Equatorial Low-Pressure Belts
4. Polar High-Pressure Belts

How many of the above pressure belts are dynamically induced?

(a) Only one
(b) Only two
(c) Only three
(d) All four

79. Consider the following information:

Local Wind	Type	Originate from
1. Sirocco	Hot wind	Sahara Desert
2. Bora	Cold wind	Rocky Mountains
3. Mistral	Cold wind	Southern France
4. Gregale	Hot wind	MacDonnell mountain range

In how many of the above rows is the given information correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

80. The planetary winds significantly influence weather patterns of various regions around the world. In this context, consider the following statements:

1. The trade winds bring rainfall to the eastern coast of continents within the tropics.
2. Westerlies bring rainfall to the western coast of continents that lie in the temperate regions.

3. The Mediterranean region receives rainfall in the winters under the influence of trade winds.

Which of the above given statements is/are correct?
(a) 1 and 2 only
(b) 1 only
(c) 2 only
(d) 1, 2 and 3

81. Consider the following statements about Tornadoes:
1. It is a narrow, violently rotating column of air that extends from a thunderstorm to the ground.
2. MSK (Medvedev-Sponheuer-Karnik) scale is used to measure the strength of a tornado.
3. Among Indian states, Gujarat and Maharashtra are most vulnerable to tornadoes.

Which of the statements given above is/are correct?
(a) 1 only
(b) 1 and 3
(c) 2 only
(d) 1 and 2

82. With reference to the Coriolis force, consider the following statements:
1. It is primarily caused due to the revolution of the earth around the sun.
2. It acts parallel to the pressure gradient force.
3. Its magnitude increases with an increase in the velocity of the wind.

Which of the statements given above is/are correct?
(a) 1 only
(b) 3 only
(c) 2 and 3
(d) 1 and 2

83. In the context of atmospheric circulation, geostrophic winds are:
(a) Winds that blow from high-pressure to low-pressure areas without any deflection.
(b) Winds that blow parallel to the isobars due to a balance between Coriolis force and pressure gradient force.
(c) Winds that blow perpendicular to the isobars under the influence of friction.
(d) Winds that spiral into low-pressure systems near the Earth's surface.

84. Westerlies generally originate in which one of the following pressure belts?
(a) Subtropical high-pressure belt.
(b) Subpolar low-pressure belt.
(c) Polar high-pressure belt.
(d) Equatorial low-pressure belt.

85. With reference to the pressure gradient, consider the following statements:
1. The vertical pressure gradient force is generally equal to the horizontal pressure gradient force.
2. Close spacing of isobars indicates a gentle pressure gradient while wide spacing represents a steep pressure gradient.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

86. With reference to the global climate system, which of the following is the main driving force of Katabatic winds?
(a) Pressure gradient force
(b) Centrifugal force
(c) Coriolis force
(d) Frictional force

87. With reference to the local wind circulation, consider the following statements about Mountain and Valley breezes in the mountainous regions:

Statement I: Valley breezes occur during the day time and mountain breezes/winds occur during the night time.

Statement II: Valley heats up and cools faster than mountain slopes.

Which one of the following is correct in respect of the above statements?
(a) Both Statement I and Statement II are correct, and Statement II is the correct explanation for Statement I
(b) Both Statement I and Statement II are correct but Statement II is not the correct explanation for Statement I
(c) Statement I is correct, but Statement II is incorrect
(d) Statement I is incorrect, but Statement II is correct

88. Consider the following statements with reference to the Hadley cell and the Ferrel cell:
1. In the Hadley cell circulation, air rises up at equator and descends at subtropical high pressure belts.

2. In the Ferrel cell circulation, the surface winds blow towards the poles.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

89. Westerlies in southern hemisphere are stronger and persistent than in northern hemisphere. Why?
1. Southern hemisphere has less landmass as compared to northern hemisphere.
2. Coriolis force is higher in southern hemisphere as compared to northern hemisphere.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

90. Which one of the following is the cause for formation of Intertropical Convergence Zone?
(a) The convergence of equatorial air mass with the tropical and sub-tropical air mass near equator.
(b) The intense heating of mid-latitude belt in summers.
(c) The convergence of northeast and southeast trade winds near equator.
(d) The high sea surface temperature and evaporation rate near equator.

91. In context to *Air Masses*, which of the following statements is correct?
(a) It is large body of air with highly variable temperature and moisture.
(b) It can extend from the ground level to the stratosphere.
(c) Air masses are not formed in the polar region.
(d) Air masses move from one region to another solely under the influence of Coriolis force.

92. Consider the following statements:
1. The factors that affect wind direction is pressure-gradient force and the Coriolis force only.
2. The friction force on the wind is more at the land surface than on the sea surface.

Which of the above statements is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

93. "Coriolis force is an apparent force caused by the earth's rotation." Which of the following statements is *incorrect* regarding Coriolis force?
(a) Coriolis force can cause the deflection of winds.
(b) The Coriolis force is zero at the equator and maximum at the poles.
(c) The rotation of the cyclones in different directions is due to Coriolis force.
(d) The Coriolis force has no effect on deep ocean currents.

4.4. Humidity and Precipitation

94. Consider the following pairs:

Terms	Description
1. Relative Humidity	It is the ratio of mass of water vapour to the total mass of the air parcel.
2. Dew Point	It is the temperature at which the air becomes fully saturated.
3. Absolute Humidity	It represents the actual amount of water vapour present in the air.

Which of the pairs given above is/are correctly matched?
(a) 1 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

95. "These are the highest clouds in the Earth's atmosphere and are observed slightly below the mesopause in the polar summertime. These clouds are of special interest, as they are sensitive to both global climate change and to solar/terrestrial influences. Both satellite and ground-based observations over the past four decades have indicated that the presence of these clouds has been increasing in both frequency and brightness. The first recorded sightings of these clouds were reported in 1885"

Which of the following types of clouds is described in the above passage?
(a) Cirrus clouds
(b) Cirrostratus clouds
(c) Noctilucent clouds
(d) Cumulonimbus clouds

96. Which of the following statements correctly describes the 'Storm Surge'?

(a) It is a rise in sea level that occurs during tropical cyclones or intense storms.
(b) It is a displacement of large volume of water caused by movements in Earth's Tectonic plates.
(c) It is an overflow of excessive water on dry land caused by large storms.
(d) None of the statements (a), (b) or (c) is the correct description.

97. "It consists of frozen raindrops and refrozen melted snow-water. When a layer of air having above- freezing point temperature overlies a subfreezing layer near the ground, precipitation takes place in this form. Raindrops leaving the warmer air, encounter the colder air below and as a result, they solidify and reach the ground as small pellets of ice not bigger than the raindrops from which they are formed."

The above description refers to which of the following types of precipitation?

(a) Snowfall
(b) Sleet
(c) Hailstones
(d) Ice-Crystal

98. Consider the following pairs:

Clouds	Description
1. Cumulus clouds	White, thin, and detached cloud having feathery appearance.
2. Stratus clouds	Clouds formed due to loss of heat and covering the large portion of the sky.
3. Nimbus clouds	They are featureless mass of vapour, thick enough to block the rays of sun.

Which of the following pairs given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

99. It is a measure of the actual amount of water vapor in the air, regardless of the air's temperature. The higher the amount of water vapor, the higher is its value. It is expressed as grams of moisture per cubic meter of air (g/m^3).

Which of the following options best describe the paragraph?

(a) Relative Humidity
(b) Dew Point Temperature
(c) Specific Humidity
(d) Absolute Humidity

100. With reference to the distribution of rainfall around the world, consider the following statements:

1. In warm temperate latitudes, the western margins of continental coast receive more rainfall than the eastern margins.
2. The entire region in the tropical belt receives rainfall more than 200 cm per annum.
3. Western parts of cool temperate regions receive rainfall throughout the year.

Which of the above given statements is/are correct?

(a) 3 only
(b) 1 and 3 only
(c) 2 only
(d) None of the above

101. With reference to convectional rainfall, consider the following statements:

1. High temperature and high humidity cause convectional rainfall near the equator, mostly in the noon.
2. Most of the rainfall that India receives is convectional in nature.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

102. Consider the following statements:

Statement I: The humidity levels during the summer season tend to be higher when compared to those experienced in winter.

Statement-II: The warmer air exhibits a greater capacity to retain moisture compared to colder air.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

103. Consider the following statements:

Statement-I: If the relative humidity is 100 percent, then the precipitation will necessarily occur.

Statement-II: A decrease in temperature leads to an increase in the relative humidity in the air.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

104. How does the atmospheric phenomenon of Fog differ from Mist?

1. Fog results from the presence of suspended water droplets, whereas mist originates from the suspension of fine dust particles in the air.
2. The Fog is much denser than the mist.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

105. Consider the following statements:

"These are the clouds with a great vertical extent, ranging from 2,000-30,000 feet. These clouds are massive and dense that resembles a massive tower. They are generally formed during tropical cyclonic conditions. They bring convectional rains and are also known as 'thunderclouds.'"

Which of the following types of clouds has been described in the above given paragraph?

(a) Altostratus clouds
(b) Stratocumulus clouds
(c) Cirrocumulus clouds
(d) Cumulonimbus clouds

106. With reference to Noctilucent Clouds (NLCs), consider the following statements:

1. They are formed in the mesosphere layer of Earth's atmosphere.
2. They are most commonly observed in the summer.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

107. The temperature of a parcel of air is said to be at dew point if:

(a) the relative humidity of the air parcel is 100%.
(b) the temperature of the air parcel is equal to its critical temperature.
(c) the relative humidity of the air parcel is 0%.
(d) the temperature of the air parcel is more than the freezing point.

108. With reference to Relative Humidity, consider the following statements:

1. It is defined as the actual amount of the water vapour present in the air at a given temperature.
2. It generally increases with an increase in the air temperature if the amount of moisture in the air is constant.
3. It is generally higher over oceans compared to land.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

109. Dew formation occurs under specific atmospheric conditions. In this context, consider the following conditions:

1. Clear sky.
2. Calm air.
3. Cold and long nights.
4. Low relative humidity.
5. Dew point is lower than the freezing point.

How many of the above conditions are favourable for the formation of dew?

(a) Only two
(b) Only three
(c) Only four
(d) All five

110. "These are clouds that form high in the troposphere and signal clear, fair weather. These clouds let pass most of the incoming solar radiation but trap the heat from getting out of the Earth system, and therefore have a net warming effect on Earth."

Which of the following types of clouds are being described in the above passage?
(a) Stratocumulus
(b) Cirrus Clouds
(c) Cumulus Clouds
(d) Stratus Clouds

111. Consider the following statements:
1. Between the latitudes 35 degree and 40 degree North and South of the equator, the rain is heavier on the eastern coasts and goes on decreasing towards the west.
2. The coastal areas receive more rainfall as compared to the interiors of the continents.
3. Between the latitudes 45 degree and 65 degree North and South of equator, the rainfall is first received on the western margins of the continents and it goes on decreasing towards the east.

Which of the above given statements is/ are correct regarding the general pattern of distribution of rainfall around the World?
(a) 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

112. In which of the following ways do the oceans affect climate and weather on earth?
1. It helps in absorbing solar radiation and releasing heat needed to drive the atmospheric circulation.
2. It helps in distributing the absorbed heat around the globe.
3. Carbon dioxide is dissolved in cold ocean water and the warm ocean water releases carbon dioxide back to the atmosphere.

Select the correct answer using the code given below.
(a) 1 and 2 only
(b) 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

113. The process where water vapor changes directly into snowflakes and frost is known as
(a) Sublimation
(b) Deposition
(c) Evaporation
(d) Evapotranspiration

114. With reference to the various forms of precipitation, consider the following statements:
1. Temperature inversion in the atmosphere helps in the formation of sleet.
2. Sleet generally forms in winter, while hail is a precipitation of warm season.
3. Size of pellets of hailstones is normally larger than the pellets of sleet.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

4.5. Climatic Processes: Cyclone, El-Nino etc.

115. Consider the following statements with reference to the Anticyclone:
1. An anticyclone is an area of high pressure where air moves apart from centre and sinks.
2. It typically indicates bad weather with high winds and excessive precipitation.
3. The anticyclone compresses air with reducing humidity and leading to fewer clouds within the anticyclone.

Which of the statements given above are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

116. Consider the following conditions:
1. Foggy weather developed during the day.
2. Clear sky conditions developed during the night.
3. Intense radiation cooling during the night.

Which of the above given conditions would be favourable for occurence of cold waves in India?
(a) 2 and 3 only
(b) 1 and 3 only
(c) 1 and 2 only
(d) 1, 2 and 3

117. Consider the following statements about the El Nino:
1. Intensity of Walker Circulation diminishes during an El Niño event.
2. Compared to normal circumstances, there will be low pressure near Peruvian coast and high pressure in the Indian Ocean during the El-Nino.

3. An El-Nino event always leads to increased occurrence of hurricanes in the mid-Atlantic Ocean.

Which of the statements given above is/are correct?
(a) 2 only
(b) 1 and 3 only
(c) 1 and 2 only
(d) 1 only

118. Which among the following is/are ideal condition(s) for the development of a thunderstorm in a region?
1. Presence of moisture in the air
2. Rapidly rising air
3. Absence of sunlight

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 1 only
(c) 2 and 3 only
(d) 1, 2 and 3

119. In context of Climatology, which of the following conditions are necessary for the occurrence of tropical cyclones?
1. Temperature higher than 27° C.
2. Presence of the Coriolis force.
3. Absence of vertical wind
4. Upper air convergence above the sea level

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 1, 2 and 4 only
(d) 1, 3 and 4 only

120. With reference to the features of tropical cyclones, consider the following statements:
1. The eyewall of a tropical cyclone is a region of calm with clear skies and subsiding air.
2. The eye is a region of intense thunderstorms that experiences the strongest winds and heaviest rainfall in the cyclone.
3. Tropical cyclones lose their intensity rapidly once they make landfall due to the lack of warm water as their energy source.

How many of the statements given above are correct?
(a) 3 only
(b) 1 and 3 only
(c) 1 and 2 only
(d) None of the above

121. The violent local storms are manifestations of the atmosphere's adjustments to varying energy distribution. In this context, consider the following statements regarding 'thunderstorms' and 'tornadoes':
1. A thunderstorm usually produces lightning without any precipitation.
2. A tornado refers to descending spiraling winds having very low pressure at the centre.

Which of the statements given above is/ are correct?
(a) Only 1
(b) Only 2
(c) Both 1 and 2
(d) Neither 1 nor 2

122. With reference to climatological phenomenon 'El Nino', consider the following statements:
1. It involves the unusual cooling of the surface waters in the eastern tropical Pacific Ocean.
2. During an El Nino event, westward-blowing trade winds strengthen along the Equator leading to dispersal of warmer water towards Western Pacific near Australian Coast.
3. It increases the risk of wildfires in the eastern region of Australia.

Which of the statements given above is/are correct?
(a) 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 only

123. With reference to the Cyclones and Anti-cyclones, consider the following statements:
1. Unlike anticyclones, all types of cyclones essentially exhibit a low-pressure centre region named 'eye'.
2. In the northern Hemisphere, Cyclones circulate in clockwise direction whereas the anti- cyclones circulate in counterclockwise movement.

Which of the statements given above is/are **incorrect**?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

124. Consider the following conditions:
1. Diverging Air
2. Temperature Contrast between two air masses.

3. Coriolis Force

How many of the above conditions are considered necessary for the formation of fronts?

(a) Only one
(b) Only two
(c) All three
(d) None

125. Consider the following statements regarding the phenomenon of 'El-Nino':

1. The weakening of trade winds is responsible for the onset of El-Nino.
2. It can lead to a Southward shift of the Pacific jet streams.
3. It weakens the Humboldt cold current near the coast of Peru.
4. It leads to extensive drought conditions across the entire globe.

Which of the above given statements are correct?

(a) 2, 3 and 4 only
(b) 1, 3 and 4 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

126. Consider the following statements regarding the characteristics of the Tropical Cyclones:

1. These cyclones have the lowest pressure in their central region.
2. These cyclones generally produce more intense rainfall than temperate cyclones.
3. These cyclones generally move west to east in both Northern and Southern hemispheres.

Which of the above given statements is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

127. With reference to the climate phenomenon known as 'El Nino', consider the following statements:

1. The weakening of the 'Walker cells' atmospheric circulation pattern often indicates the onset of the El Nino.
2. The positive Indian Ocean Dipole (IOD) event aggravates the adverse effects of El Nino on Indian monsoon.
3. The El Nino event is linked to the increased instances of forest fires in regions like Indonesia.

Which of the above given statements is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

128. Consider the following statements regarding the effects of La Niña on global climate patterns:

1. It typically leads to decreased rainfall in Southeast Asia and Australia.
2. It generally weakens the Indian monsoon, leading to below-average rainfall in India.
3. It usually intensifies upwelling at the west coast of South America.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1 only

129. With reference to frontogenesis, consider the following statements about occluded front:

Statement I: There is no cloud formation and precipitation in occluded fronts.

Statement II: It is formed when the air mass is fully lifted above the land surface.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are correct, and Statement II explains Statement I.
(b) Both Statement I and Statement II are correct and Statement II is does not explain Statement I.
(c) Statement I is correct, but Statement II is incorrect.
(d) Statement I is incorrect, but Statement II is correct.

130. Consider the following statements:

El-Nino conditions generally increases the risk of:

1. heavy rainfall on the west coast of South America
2. droughts in Northern Australia
3. increased rainfall in the Horn of Africa region
4. reduced rainfall in India

Which of the statements given above are correct?

(a) 1 and 4 only
(b) 2, 3 and 4 only
(c) 2 and 3 only
(d) 1, 2, 3 and 4

131. Consider the following statements regarding Tornadoes:

1. It is a violently rotating column of air that typically forms at the base of a thunderstorm.
2. They are restricted primarily in the equatorial and tropical regions.
3. They can occur over both land and water.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

132. In the South Atlantic and South-Eastern Pacific regions in tropical latitudes, cyclone does not originate. What is the reason?

(a) Sea surface temperatures are low
(b) Inter-tropical Convergence Zone seldom occurs
(c) Coriolis force is too weak
(d) Absence of land in those regions

4.6. Classification of Climates and Climatic Types

133. With reference to Tropical monsoon climatic regions, consider the following statements:

1. They are found in the south western parts of South America and southern Australia.
2. The seasonal reversal of winds is a feature of these climatic regions.
3. These climatic regions experience high annual rainfall, often exceeding 200 cm.
4. These climatic regions experience the highest annual temperature range among all the climatic regions.

Which of the statements given above are correct?

(a) 1 and 4 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 2, 3 and 4

134. Which of the following are the characteristic features of China type of Climate?

1. High degree of pressure variation between the summer and winter seasons.
2. Low pressure region created during the summers due to intense heating.
3. Presence of rain bearing South-west monsoon winds.
4. Very low annual temperature range.

Select the correct answer from the codes given below.

(a) 1 and 2 only
(b) 1, 3 and 4 only
(c) 2, 3 and 4 only
(d) 1, 2 and 4 only

135. With reference to the Tundra region, consider the following statements:

1. There is a general absence of tree cover in the tundra region.
2. Extraction and mining activities are totally prohibited in the Tundra region.
3. The Tundra plays a significant part in mitigating the negative impacts of carbon emission.

Which of the above statement is/are correct?

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

136. In this type of climate, rainfall occurs throughout the year. They are the regions of frontal cyclonic activity or Temperate Cyclones. It is also called as Cool Temperate Western Margin region. The climate is ideal for maximum comfort and mental alertness. Deciduous forest is the natural vegetation of this area.

Which of the options given below best describes the above climatic type?

(a) British Type Climate
(b) China Type Climate.
(c) Steppe Type Climate
(d) Siberian Type Climate

137. Consider the following pairs:

Type of grassland	Region
1. Puszta	Hungary
2. Prairies	Argentina
3. Pampas	USA
4. Canterbury	New Zealand
5. Velds	South Africa

Which of the above pairs are correctly matched?

(a) 2 and 3 only
(b) 1, 2 and 4 only
(c) 1, 4 and 5 only
(d) 3, 4 and 5 only

138. Consider the following statements regarding grasslands:

1. A high annual range of temperature is found over all the temperate grasslands.
2. Savanna Grasslands are characterized by a high diurnal range of temperature.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

139. Which of the following is the correct description of Koeppen's "C" type of climate?

(a) Sun is overhead throughout the year, with a low annual range of temperature and high annual rainfall.
(b) Climate present in mid-latitudes characterized by warm summers and mild winters.
(c) Climate having low rainfall over the region, insufficient for the growth of plants.
(d) Climate having cold winters with a large annual range of temperature.

140. Consider the following regarding the characteristics of Equatorial Regions:

1. High temperature and humidity throughout the year
2. Prevalence of bacteria and insects
3. Poor quality of soil
4. Presence of dense Forest
5. Commercial extraction of Timber is difficult

Which of the above given options are correct?

(a) 1, 3, and 5 only
(b) 1, 2, 3 and 4 only
(c) 3, 4, and 5 only
(d) 1, 2, 3, 4, and 5

141. Consider the following regions:

1. American Canadian prairies
2. European Steppes
3. Pampas of Argentina
4. Amazon Basin

In how many of the above regions is extensive commercial grain cultivation practiced?

(a) Only one
(b) Only two
(c) Only three
(d) All four

142. Consider the following statements regarding the 'Mediterranean Climate':

1. It is found mostly on the western coasts of the continents in the sub-tropical latitudes.
2. It is characterized by a hot, rainy summer and a mild, dry winter.
3. It experiences an average precipitation of more than 200 centimeters in a year.

Which of the above given statements is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

143. Consider the following regions:

1. Northern Australia
2. South Asia
3. Southeast Asia
4. North-Eastern part of South America

In how many of the above-mentioned regions can 'Tropical Monsoon Climate' be found?

(a) Only one
(b) Only two
(c) Only three
(d) All four

144. Consider the following statements regarding the tundra type of climate and vegetation:

1. Tundra type of climate is found only in the Northern Hemisphere.
2. Tundra climate is characterized by very low duration of daylight throughout the year.
3. Rubber trees generally belong to the Tundra type of vegetation.

How many of the statements given above are **incorrect?**

(a) Only one
(b) Only two
(c) All three
(d) None

145. The Equatorial region has no other season except summer. What could be the reason?

1. The length of day and night is more or less equal over the year.
2. The Earth's rotational velocity is maximum at the Equator.

Select the correct answer using the codes given below:

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

146. The seasonal reversal of winds is the typical characteristic of
(a) Subtropical steppe climate
(b) Monsoon climate
(c) Equatorial climate
(d) Tundra climate

147. Why is there a great difference between the annual range of temperature between the steppes in the northern and southern hemispheres?
(a) Orographic rainfall in the northern hemisphere brings down the temperature.
(b) Chinook, a hot local wind increases the temperature of northern steppes.
(c) Continentality feature of the region in northern hemisphere and maritime influence in the southern hemisphere.
(d) Impact of climate change is more severe on the Southern hemisphere compared to the northern hemisphere.

148. A particular climate has the following characteristics:
1. Cold, dry winters and warm, wet summers
2. Cool temperate forests as predominant vegetation.
3. It is absent in the Southern Hemisphere.

Which one among the following climates has all the above given characteristics?
(a) British Type of Climate
(b) Laurentian Type of Climate
(c) Mediterranean Type of Climate
(d) Siberian Type of Climate

149. Consider the following Deserts of the world:
1. Namib Desert
2. Sahara Desert
3. Atacama Desert
4. Gobi Desert

Cold ocean currents play a significant role in formation of how many of the deserts given above?
(a) Only one
(b) Only two
(c) Only three
(d) All four

150. With reference to the Mediterranean climate, consider the following statements:

Statement-I: The regions experiencing Mediterranean climate receive most of their rainfall in the winter season.

Statement-II: Mediterranean climate is mainly formed by onshore Polar easterlies in winters that migrate towards the pole during the summer season.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

151. Consider the following characteristics:
1. Mainly observed in the eastern margin of the continents.
2. Narrow annual temperature range.
3. Dry summers and wet winters.
4. Strong maritime influence.

How many of the above characteristics are common between China type, Natal type and Gulf type of climates?
(a) Only one
(b) Only two
(c) Only three
(d) All four

152. With reference to various types of grasslands spread across the world, consider the following grasslands:
1. Steppes
2. Prairie
3. Pampas
4. Downs
5. Llanos
6. Campos

How many of the above are temperate grasslands?
(a) Only two
(b) Only three
(c) Only four
(d) Only five

153. With reference to the Equatorial Vegetation, consider the following statements:
1. It has a distinctive layered arrangement of vegetation due to the competition for sunlight.
2. The equatorial forests have a lesser variety of tree species compared to temperate forests.
3. Sandalwood and bamboo are the primary commercial tree species of Equatorial Vegetation.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) None of the above

154. Consider the following features:

1. Presence of regular land and sea breezes.
2. Very high diurnal range of temperature.
3. Absence of specific Winter season.
4. High rainfall throughout the year.

How many of the above are the features of Equatorial Climate?

(a) Only one
(b) Only two
(c) Only three
(d) All four

155. Which of the following statements is/are correct regarding the British Type Climate?

1. Southern Chile and Tasmania experience this type of climate.
2. Westerlies significantly influence the weather conditions in this type of climate.
3. Trees in this climatic region do not shed their leaves throughout the year.

Select the answer from the code given below:

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 2 and 3 only

156. Consider the following regions of the world:

1. Newfoundland, Canada
2. California, USA
3. Manchuria, China
4. New England, USA

How many of the regions given above experience the Cool Temperate Eastern Margins or Laurentian type of Climate?

(a) Only one
(b) Only two
(c) Only three
(d) All four

157. Consider the following regions:

1. Central California
2. Newfoundland
3. Central Chile
4. Southern Chile
5. South western Australia

In which of the above mentioned regions is the Mediterranean type of climate found?

(a) 1, 2 and 4 only
(b) 2, 3 and 5 only
(c) 1, 3 and 5 only
(d) 1, 3, 4 and 5 only

158. "In this climate region the air masses are generally unstable and cause rainfall throughout the year. The annual averages of precipitation vary from 75-150 cm. The daily range of temperature is small in this climate type. Thunderstorms in summer and frontal precipitation in winter are common. This climatic region occurs in the eastern United States of America, southern and eastern China, southern Japan, northeastern Argentina, coastal south Africa and eastern coast of Australia".

The above description is about which one of the following Climate regions given below?

(a) Humid Subtropical Climate
(b) Marine West Coast Climate
(c) Warm Temperate (Mid-Latitude) Climate
(d) Tropical Wet Climate

159. Consider the following statements:

Statement I: The Cool Temperate Continental (Siberian) Climate is absent in the Southern Hemisphere.

Statement II: Southern hemisphere is characterized by the narrowness of the continents in the high latitudes.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are correct, and Statement II explains Statement I.
(b) Both Statement I and Statement II are correct, but Statement II does not explain Statement I.
(c) Statement I is correct, but Statement II is incorrect.
(d) Statement I is incorrect, but Statement II is correct.

160. Consider the following information:

Climatic Type	Region	Feature
1. British Type Climate	New Zealand	Rainfall occurs throughout the year with maximum in winter or autumn.
2. Savanna Type Climate	Congo	Uniformity in temperature throughout the year.

3. Laurantian Type Climate	New found land	Cold, dry winters and warm wet summers

In which of the above rows is the given information correctly matched?

(a) 1 only
(b) 1 and 2
(c) 2 and 3
(d) 1 and 3

161. With reference to frontal zones, consider the following statements:

1. Cold fronts are usually associated with thunderstorms and extreme weather.
2. The stationary fronts can be transformed into both warm and cold fronts.
3. An occluded front is formed when a cold front overtakes a warm front.

Which of the statements above is/are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

162. "This type of climate is entirely confined to the western portion of continental masses, between 30° and 40° north and south of equator. The basic cause of this type of climate is shifting of wind belts. It is characterised by dry summer and wet winter."

Which one of the following climatic regions is described in the above given paragraph?

(a) China Type Climate
(b) Hawaiian Type Climate
(c) Mediterranean Type Climate
(d) Savannah Type Climate

163. Deserts around the world receive very little rainfall because:

1. They are located in interior drainage basins far from oceans.
2. They are located on the protected side of mountain ranges.
3. They are affected by cold ocean currents that parallel the coast.

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) All of the above

164. Consider the following statements:

1. While warm deserts occur in tropical areas, cold deserts occur exclusively in areas beyond the Arctic Circle.
2. Sand dunes are not prominent features in cold deserts.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

4.7. Natural Vegetation

165. Consider the following:

The vegetation in desert areas:

1. have deep taproots or an extensive lateral root system.
2. have succulent stems.
3. have seeds with hard, impermeable coatings.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

166. Consider the following sets of pairs:

Index Plant	Most Favorable Climate region for the Plant
1. Olive	Tropical Monsson climate
2. Cactus	Hot Desert Climate
3. Spruce	Warm Temperate Eastern Margin Climate

How many of the above given pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

167. Consider the following information:

Desert	Region	Reason for the formation
1. Kalahari	Southern Africa	Located in Subtropical high-pressure belt

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2. Atacama	South America	Influence of the Peruvian (Humboldt) current
3. Patagonian	Central Asia	Located in the Rain Shadow region.

In how many of the above rows is the given information correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

168. Consider the following statements with reference to Mediterranean agriculture:
1. It is usually characterized by the cultivation of crops adapted to hot dry summers and wet winters.
2. This type of agriculture can be found in Central Chile and Western Cape province of South Africa.

Which of the above given statements are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

169. Xerophytes are predominantly and most likely to be found in which of the following climate types?
(a) Tropical rainforest
(b) Temperate oceanic climate
(c) Continental climate
(d) Dry desert Climate

170. This type of vegetation features short grasses with very few trees. It has hot summers and cold winters and is found in parts of Eurasia. The type of vegetation refers to-
(a) Tropical Savannah
(b) Cold Dessert
(c) Boreal forest
(d) Temperate Steppe

171. Consider the following description:

"These forests are characterized by cold temperatures, short growing seasons, and coniferous trees. These forests are found in the high latitudes of the Northern Hemisphere, primarily in Canada, Alaska, Scandinavia, and Russia. The soil in these forests is thin and nutrient-poor, and the vegetation is adapted to survive harsh conditions such as cold temperatures and permafrost."

Which of the forest types is mentioned in the above paragraph?
(a) Tropical rainforest
(b) Temperate deciduous forest
(c) Tundra forest
(d) Mediterranean forest

172. With reference to the Equatorial Rainforests, consider the following statements:
1. These forests are characterized by the presence of Lianas and Epiphytes.
2. Tropical rain forests in the Amazon Basin are called Selvas.
3. Equatorial forests are highly conducive for commercial exploitation of timber.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 2 only
(d) 1 and 3 only

173. Consider the following statements regarding the Taiga or Boreal forests:
1. It is the world's largest land biome in terms of area.
2. They are only found in the Northern Hemisphere, and not found in the Southern Hemisphere.
3. Trees are completely absent in these forests.

Which of the statements given above are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

174. Which of the following statements is incorrect regarding the Tropical Moist Deciduous forests?
(a) These forests are found in areas with rainfall between 100-200 cm per annum.
(b) These forests are widely distributed covering both in southern and northern states including Tamil Nadu and Arunachal Pradesh.
(c) The trees in these forests mostly shed their leaves during the winter season.
(d) Generally, these types of forests have a lower number of tree species compared to tropical evergreen forests.

175. Consider the following statements regarding the characteristics/features of vegetation in the Savannah region:

1. Trees do not shed their leaves in the dry season.
2. Grasses have deep root systems.
3. Many tree species are characterized by small or needle-shaped leaves.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

176. With reference to Teak tree (Tectona grandis), consider the following statements:

1. It is native to all continents of the earth except Antarctica.
2. India is the largest producer of teak in the world.
3. As per the Forest Rights Act 2006, it is classified as a Minor Forest Produce.

Which of the statements given above are **incorrect**?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

177. Consider the following statements:

Statement I: Coniferous forests are characterized by trees with needle-like leaves.

Statement II: The needle-like leaves in trees help them to survive extreme cold winters.

Which one of the following is correct in respect of the above statements?

(a) Both Statement I and Statement II are correct and Statement II explains Statement I.
(b) Both Statement I and Statement II are correct, but Statement II does not explain Statement I.
(c) Statement I is correct, but Statement II is incorrect.
(d) Statement I is incorrect, but Statement II is correct.

178. Consider the following factors:

1. Scanty rainfall
2. Severe winters
3. Frequent droughts
4. Lack of maritime influence
5. Influence of easterly winds

How many of the above factors are primarily responsible for the scarcity of trees in the steppe climate?

(a) Only two
(b) Only three
(c) Only four
(d) All five

179. Consider the following grasslands:

1. Pustaz
2. Pampas
3. Llanos
4. Velds
5. Canterbury grasslands

How many of the above are type of temperate grasslands?

(a) Only two
(b) Only three
(c) Only four
(d) All five

180. Consider the following statements:

In this vegetation type:

1. hardwood tree species such as mahogany and ebony are predominantly found.
2. a thick layer of ferns and shrubs thrives under the canopy of the tall trees.
3. epiphytes and parasitic plants grow on the branches of trees.

Which one of the following vegetation types is described in the above statements?

(a) Temperate Deciduous Vegetation
(b) Mediterranean Vegetation
(c) Equatorial Vegetation
(d) Taiga Vegetation

181. With reference to Temperate Grasslands, consider the following pairs:

Grasslands	Region Associated with
1. Pustaz	Kenya
2. Downs	Australia
3. Velds	South Africa
4. Prairies	Ukraine

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

SOLUTIONS

4.1. Structure and Composition of Atmosphere

1. Solution: (a)

Exp) Option a is the correct answer.

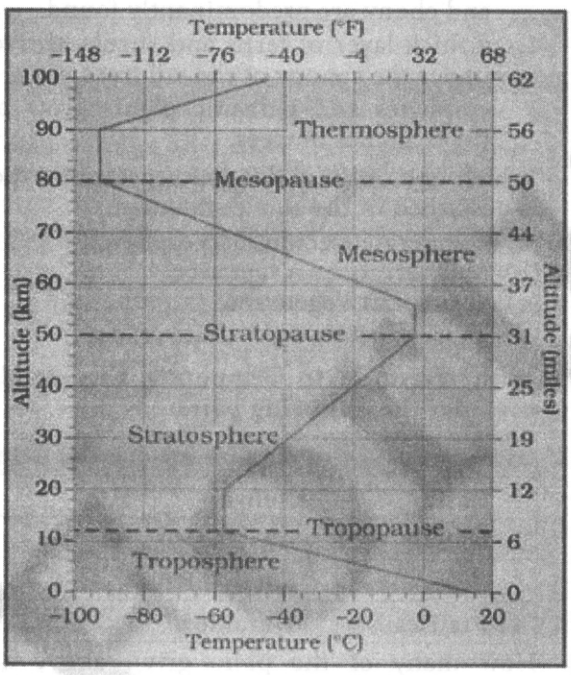
The troposphere is the lowermost layer of the atmosphere. Its average height is 13 km and extends roughly to a **height of 8 km near the poles and about 18 km at the equator.**

Option a is correct. The troposphere is thickest at the equator, and much thinner at the North and South Poles because the equator is warmer and heat is transported to great heights by strong convectional currents. Thus, **convection currents transport heat to greater heights at the equator than the poles** due to heat difference on Earth. This also implies that the warmer the weather, the thicker is the troposphere.

2. Solution: (b)

Exp) Option b is the correct answer.

The Earth's atmosphere is divided into five layers based on characteristics like temperature. These layers are - troposphere, stratosphere, mesosphere, thermosphere and exosphere. The troposphere is the **lowest atmospheric layer.**



Statement 1 is correct. The majority of the mass of the entire atmosphere is contained in the troposphere—between approximately 75 and 80 percent.

Statement 2 is incorrect. Stratosphere (and not troposphere) is calm with little turbulence. Strong horizontal winds blow in the stratosphere, but there is little turbulence. This is ideal for planes that can fly in this part of the atmosphere. In contrast, the **troposphere tends to change suddenly and violently.** Air masses, areas of high-pressure and low-pressure systems, are moved by winds in the troposphere. These weather systems **lead to daily weather changes as well as seasonal weather patterns** and climate systems, such as El Nino.

Statement 3 is correct. Most of the **water vapour** in the atmosphere, along with **dust and ash particles, are found** in the troposphere. Thus, **most of Earth's clouds are located** in this layer. Clouds, from low-lying fog to thunderheads to high-altitude cirrus, form in the troposphere. This is the most important layer for all biological activities. All changes in climate and weather take place in this layer. The temperature in this layer decreases at the rate of 1°C for every 165m of height.

Important Tips

Other features of troposphere:

- The top of the troposphere is higher in summer than in winter.
- Solar heat penetrates the troposphere easily. This layer also absorbs heat that is reflected back from the ground in a process called the greenhouse effect.
- Fast-moving, high-altitude winds called jet streams swirl around the planet near the upper boundary of the troposphere. Jet streams are extremely important to the airline industry. Aircraft save time and money by flying in jet streams instead of the lower troposphere, where air is thicker.

3. Solution: (c)

Exp) option c is the correct answer.

Statement 1 is correct. UV radiation is divided into three categories, based on its wavelength; these are referred to as UV-A (400–315 nm), UV-B (315–280 nm), and UV-C (280–100 nm). Ozone is transparent to most UV-A, so most of this longer-wavelength UV radiation reaches the surface, and it constitutes most of the UV reaching the Earth. This type of UV radiation is significantly less harmful to DNA, although it may still potentially cause physical damage, premature aging of the skin, indirect genetic damage, and skin cancer.

Statement 2 is correct. Carbon tetrachloride (CCl_4) is a long-lived greenhouse gas and an ozone-depleting substance. Its emissive use, production and consumption are regulated under the Montreal Protocol on Substances that Deplete the Ozone Layer

4. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct. The ionosphere is home to many low-Earth orbiting satellites, including the International Space Station. It also acts as a conduit for many of our communications signals, such as radio waves and the signals that make GPS systems work. Particles in the ionosphere

carry electrical charges that can disrupt communications signals, induce electrical charge in low-Earth orbiting satellites, and, in extreme cases, spark power outages on the ground. Unpredicted changes in the ionosphere, such as ripples and bubbles of dense plasma, can have significant impacts on our technology and communication systems.

Statement 2 is incorrect. In the ionosphere, **temperature starts increasing with the increasing height.** The radiation from the sun is so powerful that it ionizes, or breaks electrons free from different atoms present in the atmosphere **Ionization processes release energy which heat up the upper atmosphere.** So temperature increases with height in the ionosphere region to the extent that by 150-200km, the Earth's atmosphere is extremely hot compared to surface temperatures Hence this statement is incorrect.

Statement 3 is correct. Due to the ability of ionized atmospheric gases to refract high frequency, the ionosphere can reflect and modify radio waves directed into the sky, back towards the earth which helps in communication and navigation for long distances.

5. Solution: (c)

Exp) Option c is the correct answer.

Dust is defined as sediment particles less than 100 μm in diameter. Dust can travel substantial distances from continent to continent and across oceans and affects all of Earth's climatic zones from the tropics to the poles. Atmosphere has a sufficient capacity to keep small solid particles, which may originate from different sources and include sea salts, fine soil, smoke-soot, ash, pollen, dust and disintegrated particles of meteors. Dust particles are generally concentrated in the lower layers of the atmosphere; yet, convectional air currents may transport them to great heights.

The **higher concentration of dust particles is found in subtropical and temperate regions** due to **dry winds in comparison to equatorial and polar regions.** Dust and salt particles act as hygroscopic nuclei around which water vapour condenses to produce clouds. Polar regions are ice covered and so cannot be dusty. Equatorial regions are either in oceans or there are dense equatorial rainforests in South America and Africa. Hence there is very little dust there.

Option a is incorrect: Anticyclones are high-pressure systems and are more common in subtropical high-pressure belts and polar high-pressure belts where the air is sinking from the upper troposphere to the lower troposphere. The **average velocity of an anticyclone is 30 to 50 km per hour.** It is not the reason for the higher concentration of dust particles found in subtropical and temperate regions.

Option b is incorrect: The subtropical high pressure is located at 30 degrees and 35 degrees both north and south. The air in this region is comparatively dry and calm. It is not the reason for the higher concentration of dust particles found in subtropical and temperate regions.

Option d is incorrect: The elevation of Continental landmass is not related to the higher concentration of dust particles found in subtropical and temperate regions.

6. Solution: (d)

Exp) Option d is the correct answer.

Main gases of the atmosphere are nitrogen, oxygen, water vapour, carbon dioxide, methane, nitrous oxide, and ozone. These gases are extremely important to the health of the Earth's biosphere.

Statement 1 is correct: Water vapor is Earth's most abundant greenhouse gas. **It is responsible for about half of Earth's greenhouse effect** — the process that occurs when gases in Earth's atmosphere trap the Sun's heat. Greenhouse gases keep our planet liveable. It absorbs parts of the insolation from the sun and preserves the earth's radiated heat. It thus, acts like a blanket allowing the earth neither to become too cold nor too hot.

Statement 2 is correct: Water vapour is a variable gas in the atmosphere, which decreases with altitude. Water vapour **decreases from the equator towards the poles.** The highest concentrations of water vapour are found near the equator over the oceans and tropical rain forests. Cold polar areas and subtropical continental deserts are locations where the volume of water vapour can approach zero percent.

Statement 3 is correct: Water vapour has several very important functional roles on our planet. It **redistributes heat energy on the Earth** through latent heat energy exchange. Heat radiated from Earth's surface is absorbed by water vapor molecules in the lower atmosphere. The water vapor molecules, in turn, radiate heat in all directions. Some of the heat returns to the Earth's surface. Thus, water vapor is a second source of warmth (in addition to sunlight) at the Earth's surface.

7. Solution: (c)

Exp) Option c is the correct answer.

The **hydrological cycle, also known as the water cycle,** is a continuous and natural process that describes the circulation of water on, above, and below the Earth's surface. It involves various interconnected processes such as **evaporation, condensation, precipitation, transpiration, and runoff, driven by solar energy and gravity.**

Option 1 is correct: Evaporation is the process by which **water changes from a liquid state to a gaseous state (water vapor)** due to the input of heat energy, typically from the sun. Water from oceans, lakes, rivers, or other surface water bodies absorbs heat, gains energy, and transforms into water vapor rising into the atmosphere.

Option 2 is correct: Precipitation refers to any **form of water, liquid or solid, falling from the atmosphere to the Earth's surface.** Common forms of precipitation include **rain, snow, sleet, and hail.** This process replenishes water sources on Earth.

Option 3 is incorrect: Hydration generally refers to the **process of adding water to a substance or the chemical combination of a substance with water molecules.** In the context of the hydrological cycle or water cycle, **hydration is not a specific phase or process.** However, in other contexts, it can refer to various processes where water is added to

a material, such as the absorption of water by soil or the incorporation of water molecules into a chemical compound. **The term is commonly used in chemistry and biology to describe reactions involving water.**

Option 4 is correct: Transpiration is the **release of water vapor from plants into the atmosphere.** Plants absorb water from the soil through their roots. This water travels through the plant and is released into the air through small pores (stomata) in the leaves.

Option 5 is correct: Condensation is the process **by which water vapor in the air cools and transforms back into liquid water,** forming clouds. As warm, moist air rises and cools at higher altitudes, the water vapor condenses into tiny water droplets or ice crystals, creating clouds.

8. Solution: (c)

Exp) Option c is the correct answer.

The atmosphere consists of different layers with varying density and temperature. Density is highest near the surface of the earth and decreases with increasing altitude. The column of atmosphere is divided into five different layers depending upon the temperature condition. They are: troposphere, stratosphere, mesosphere, thermosphere and exosphere.

Pair 1 is correctly matched: Stratosphere is located between approximately 12 and 50 kilometres above Earth's surface. It is **best known as home to Earth's ozone layer**, which protects us from the Sun's harmful ultraviolet radiation. Because of that UV radiation, the higher up you go into the stratosphere, the warmer temperatures become. The stratosphere is **nearly cloud- and weather-free**, but polar stratospheric clouds are sometimes present in its lowest, coldest altitudes. It's also the highest part of the atmosphere that jet planes can reach.

Pair 2 is correctly matched: Thermosphere is located between about 80 and 700 kilometres above Earth's surface, whose lowest part contains the ionosphere. In this layer, **temperatures increase with altitude due to the very low density of molecules** found here. It is both cloud- and water vapor-free. The aurora borealis and aurora australis are sometimes seen here. The International Space Station orbits in the thermosphere.

Pair 3 is incorrectly matched: Mesosphere is located between about 50 and 80 kilometre above Earth's surface, the mesosphere gets progressively colder with altitude. In fact, the top of this layer is the coldest place found within the Earth system, with an average temperature of about minus 85 degrees Celsius (minus 120 degrees Fahrenheit). The very scarce water vapor present at the top of the mesosphere forms noctilucent clouds, the highest clouds in Earth's atmosphere, which can be seen by the naked eye under certain conditions and at certain times of day. **Most meteors burn up in this atmospheric layer. Sounding rockets and rocket-powered aircraft** can reach the mesosphere.

Most Earth satellites orbit in the exosphere and aurora borealis and aurora australis are seen in the thermosphere.

9. Solution: (c)

Exp) Option c is the correct answer.

Milankovitch cycles, also known as Milankovitch oscillations or orbital variations, **are a set of predictable changes in Earth's orbit and axial tilt that affect the climate over long periods of time.** The study of Milankovitch oscillations provides a critical framework for understanding the cyclical nature of ice ages and interglacial periods throughout Earth's climatic history, contributing valuable insights into the mechanisms driving long-term climatic shifts.

These oscillations are defined by three main factors related to Earth's orbit: how round or stretched it is (eccentricity), how much it tilts (obliquity or axial tilt), and how it wobbles or rotates (precession).

10. Solution: (c)

Exp) Option c is the correct answer.

The term "greenhouse gases" refers to gases in Earth's atmosphere that have the ability to trap heat. They contribute to the greenhouse effect, which is essential for maintaining the planet's temperature within a range suitable for life. However, these gases are now out of natural balance in the atmosphere and threaten to drastically change the climate, endangering the survival of various species on the Earth.

Option 1 is correct: Nitrous oxide (N_2O) is a greenhouse gas. It is released through various human activities, including agricultural practices and industrial processes.

Option 2 is correct: Hydrofluorocarbons (HFCs) are synthetic gases commonly used in refrigeration, air conditioning, and insulation. They have a **high global warming potential and contribute to the greenhouse effect.**

Option 3 is correct: Similar to HFCs, hydrochlorofluorocarbons are synthetic gases used in various industrial applications. **They also have ozone-depleting potential and contribute to the greenhouse effect.**

Option 4 is incorrect: Carbon monoxide (CO) is not typically considered a potential greenhouse gas. While it can indirectly contribute to climate change by influencing the atmosphere's chemical composition, its primary environmental impact is related to air quality and human health.

Option 5 is incorrect: Argon is not a greenhouse gas. It is an inert gas that does not actively participate in the greenhouse effect.

Option 6 is correct: Ozone (O_3) plays a dual role. In the stratosphere, it forms the ozone layer, protecting life on Earth from harmful ultraviolet radiation. **However, at lower altitudes (i.e. tropospheric ozone), ozone is a component of smog and acts as a greenhouse gas.**

11. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: The term **"ozone hole"** is specifically associated with regions where the total ozone concentration

falls below a certain threshold, **which is 220 Dobson units**. An ozone hole does not mean a total absence of ozone concentration, rather it implies thinning of the ozone layer. **The Dobson Unit is the most common unit for measuring ozone concentration. The average thickness of the ozone layer is around 300 Dobson units**, which represents a thickness of roughly 3 millimeters.

Statement 2 is correct: Polar Stratospheric Clouds (PSCs), particularly over Antarctica, play a crucial role in ozone depletion. **These clouds provide a surface for chemical reactions that release ozone-depleting substances, such as chlorine and bromine, leading to the destruction of ozone molecules in the stratosphere**. The ozone hole is most pronounced over Antarctica due to such unique conditions present there.

Statement 3 is incorrect: Hydrofluorocarbons (HFCs) are not ozone-depleting substances. Unlike chlorofluorocarbons (CFCs) and certain other compounds, **HFCs do not contain chlorine or bromine, which are the primary elements responsible for ozone depletion**. However, while HFCs do not contribute to ozone depletion, **they are potent greenhouse gases** and have a high global warming potential.

Important Tips

Most atmospheric ozone is concentrated in a layer in the stratosphere, about 9 to 18 miles (15 to 30 km) above the Earth's surface.

1. Ozone is a molecule that contains three oxygen atoms. At any given time, ozone molecules are constantly formed and destroyed in the stratosphere.
2. When chlorine and bromine atoms come into contact with ozone in the stratosphere, they destroy ozone molecules.
3. One chlorine atom can destroy over 100,000 ozone molecules before it is removed from the stratosphere.
4. Ozone can be destroyed more quickly than it is naturally created.
5. Some compounds release chlorine or bromine when they are exposed to intense UV light in the stratosphere. These compounds contribute to ozone depletion and are called ozone-depleting substances (ODS).
6. ODS that release chlorine include chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), carbon tetrachloride, and methyl chloroform. ODS that release bromine include halons and methyl bromide.
7. Although ODS are emitted at the Earth's surface, they are eventually carried into the stratosphere in a process that can take as long as two to five years.

12. Solution: (c)

Exp) Option c is the correct answer.

The ozone layer is a thin part of the Earth's atmosphere that absorbs almost all of the sun's harmful ultraviolet light. The ozone layer is found in the lower stratosphere at a height of roughly 20-40km.

Statement 1 is correct. Within days of the ozone layer's disappearance, the intensity of the sun's radiation would make photosynthesis — a process by which plants convert light energy into chemical energy to fuel their growth — an impossibility for all. And even these holdouts, primarily massive trees, would eventually die, too. Without plants, the food chain would collapse.

Statement 2 is incorrect. Mesosphere (and not ozone layer) takes care of extra-terrestrial objects like meteors which get burnt up while passing through this layer due to friction.

Statements 3 and 4 are correct. Stratospheric ozone is a naturally occurring gas that filters the sun's ultraviolet (UV) radiation. A diminished ozone layer allows more UV radiation to reach the Earth's surface. For people, overexposure to UV rays can lead to skin cancer, cataracts in eyes, and weakened immune systems. Increased UV can also lead to reduced crop yield and disruptions in the marine food chain.

13. Solution: (c)

Exp) Option c is the correct answer.

For climate change, the most important greenhouse gas is carbon dioxide, which is why we hear so many references to "Carbon and Carbon Dioxide" when people talk about climate change.

Statement I is correct: Carbon dioxide (CO_2) is classified as a **greenhouse gas due to its role in the greenhouse effect and its ability to trap heat in the Earth's atmosphere**. Greenhouse gases, including carbon dioxide, methane, nitrous oxide, and others, contribute to the natural greenhouse effect, which is essential for maintaining Earth's temperature within a range suitable for life.

Statement II is incorrect: CO_2 is transparent to the incoming solar radiation but opaque to the outgoing terrestrial radiation. Carbon Dioxide **primarily absorbs and re-emits outgoing terrestrial (infrared) radiation**, particularly from the Earth's surface. CO_2 does not absorb incoming solar radiation directly.

14. Solution: (c)

Exp) Option c is the correct answer.

The atmosphere is structured into layers of varying density and temperature. Density is greatest close to the Earth's surface and diminishes as altitude increases. The atmosphere is categorized into five layers based on temperature: **troposphere, stratosphere, mesosphere, thermosphere, and exosphere.**

Statement 1 is correct: The troposphere is the lowest layer of the atmosphere, ranging from about **8 kilometres near the poles to 18 kilometres at the equator. It's thickest near the equator due to strong convection currents carrying heat upwards and thinner at poles due to weak convection current.** Most of the weather changing phenomena occur here, and it's crucial for life on Earth. The temperature decreases as one goes higher, dropping about 1 degree Celsius for every 165 meters.

Statement 2 is incorrect: Above the troposphere is the stratosphere, extending up to 50 kilometres. It contains the ozone layer, which shields Earth from harmful UV radiation. Furthermore, **it has very little water vapor, and hence the cloud formation is very less (called the stratospheric clouds), when compared to the Troposphere.** Clouds form when water vapor in the air cools and condenses into water droplets. Also, it is important to be noted here that temperature increases with altitude in this layer.

Statement 3 is correct: Beyond the Stratosphere lies the **Mesosphere, reaching up to 80 kilometres.** Here, temperatures drop again, reaching as low as minus 100 degrees Celsius at 80 kilometres. **It is the coldest layer of the atmosphere.**

Statement 4 is correct: The Ionosphere reflects radio waves transmitted from Earth back to the surface. The ionosphere, situated between 80 and 400 kilometres above the mesopause, contains electrically charged particles called ions. Temperature increases with altitude in the Ionosphere.

Important Tips

The **uppermost layer of the atmosphere above the ionosphere is known as the exosphere**. This is the highest layer but very little is known about it. Its contents are rare in nature, and gradually merges with the outer space

15. Solution: (a)

Exp) Option a is the correct answer.

The atmosphere consists of different layers with varying density and temperature. The atmosphere is divided into five different layers: troposphere, stratosphere, mesosphere, thermosphere and exosphere.

Row 1 is correct. The Stratosphere is the second layer from below. It is found above the tropopause from 12km and extends up to a height of 50 km. **The Stratosphere contains the ozone layer that absorbs ultraviolet radiation** from the Sun. It thus shields life on the earth from intense, harmful forms of energy. **The temperature in the stratosphere increases with altitude.**

The Stratosphere is the ideal region for flying aeroplanes as it is nearly cloud- and weather-free.

Row 2 is incorrect. The Mesosphere lies above the stratosphere, and extends up to a height of 80 km. **In this layer, temperature starts decreasing with the increase in altitude.**

The space shuttle and the **International Space Station** both orbit Earth **within the thermosphere and not mesosphere.**

Row 3 is incorrect. The lower part of the thermosphere contains the ionosphere, which is located **between 80 and 400 km**. It contains electrically charged particles known as ions, and hence, it is known as ionosphere. **Radio waves transmitted from the earth are reflected back to the earth by this layer.**

The temperature of the thermosphere gradually increases with height as the incoming high energy ultraviolet and x-ray radiation from the sun are absorbed by the molecules in this layer.

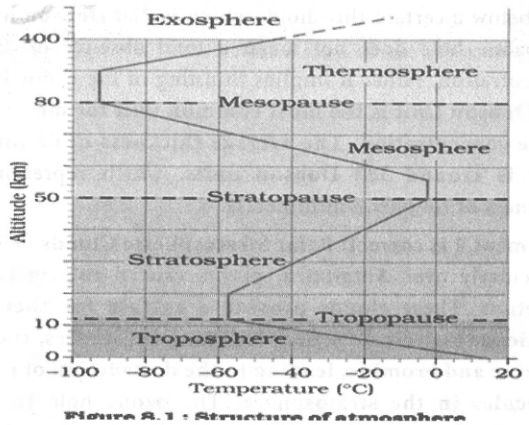


Figure 8.1 : Structure of atmosphere

Important Tips

The Troposphere is the lowermost layer of the atmosphere. Its average height is 13 km and extends roughly to a height of 8 km near the poles and about 18 km at the equator. The temperature in this layer decreases with increase in height, at the rate of 1°C for every 165 m of height. All changes in climate and weather take place in this layer. Most of Earth's weather happens here, and almost all clouds that are generated by weather are found here.

16. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct. Water vapour is a variable gas in the atmosphere. The volume of water vapour in the atmosphere generally decreases as we move from the equator towards the poles. It also decreases with altitude.

In the warm and wet tropics, water vapour may account for four per cent of the air by volume, while in the dry and cold areas of desert and polar regions, it may be less than one per cent of the air.

Statement 2 is correct. Water Vapour absorbs parts of the insolation from the sun and preserves the earth's radiated heat. It also absorbs the Earth's emitted longwave infrared radiation i.e. terrestrial radiation.

Terrestrial radiation refers to the longwave low-energy radiation emitted by the Earth.

Statement 3 is correct. Water vapor is Earth's most abundant greenhouse gas. Water Vapour is also responsible for almost half of the Earth's total greenhouse effect.

Important Tips

Water vapor is the most abundant greenhouse gas in the atmosphere. Human activities have only a small direct influence on atmospheric concentrations of water vapor, primarily through irrigation and deforestation, so it is not included in this indicator. The surface warming caused by human production of other greenhouse gases, however, leads to an increase in atmospheric water vapor because warmer temperatures make it easier for water to evaporate and stay in the air in vapor form. This creates a positive "feedback loop" in which warming leads to more warming.

17. Solution: (a)

Exp) Option a is the correct answer.

Option 1 is correct: The **Troposphere** is the **lowest layer of the Earth's atmosphere**, where most of the weather phenomena occur, including clouds, rain, and storms. It extends from the surface up to approximately **8 km at the poles** and **16 km at the equator**.

1. In the troposphere, **temperature decreases with increasing altitude**. This is primarily due to the fact that the Earth's surface absorbs solar radiation and heats the air directly above it.
2. As you move higher, the air is less dense and contains less heat, leading to cooler temperatures. In the troposphere, the temperature decreases with altitude at an average rate of **6.5°C per km (lapse rate).**

Option 2 is incorrect: The **Stratosphere**, located above the troposphere, extends from about **8-16 km** (tropopause) **to 50 km** (stratopause).

1. This layer is characterized by an **increase in temperature with rise in altitude**, which is in contrast to the troposphere.
2. The reason for this warming is the presence of the **ozone layer**, which absorbs ultraviolet (UV) radiation from the Sun. This absorption converts UV energy into heat, causing the temperature to rise as you move higher in this layer.

Option 3 is correct: The **Mesosphere** lies above the stratosphere and **extends from 50 km to about 80-85 km.**

1. It is the **coldest layer of the atmosphere**, and here, the **temperature decreases with altitude**.
2. Unlike the stratosphere, the mesosphere lacks a significant heat source, as there is little absorption of solar radiation. Additionally, the **air density in this layer is very low**, which contributes to the drop in temperature.
3. The mesosphere is also the region where most **meteors burn up** upon entering Earth's atmosphere.

Option 4 is incorrect: The **Thermosphere** is the layer above the mesosphere and **extends from about 80-85 km to more than 400 km**.

1. This layer exhibits a **significant increase in temperature with rise in altitude.**
2. The sparse gas molecules present in this layer **absorb high-energy solar radiation, such as X-rays and ultraviolet rays**, causing them to become highly energized. As a result, the **temperature can rise to over 2,000°C or more.**
3. However, despite these high temperatures, the layer would not feel hot to a human because the air density is extremely low, and there are too few particles to transfer heat effectively.

18. Solution: (b)

Exp) Option b is the correct answer.

The atmosphere is composed of gases, water vapour and dust particles. The atmosphere envelops the Earth all round. It consists of several gases with the top four being Nitrogen, Oxygen, Argon and Carbon Dioxide. These top four gases make up 99.998% of all gases.

Option 4: Argon constitutes **0.93%** of Earth's atmosphere. Argon is used in light bulbs, in double-pane windows, and to preserve museum objects.

Option 2: Carbon Dioxide constitutes **0.042%** of Earth's atmosphere. Carbon dioxide is a greenhouse gas. Plants use carbon dioxide to make food through photosynthesis.

Option 3: Helium constitutes **0.000524%** of Earth's atmosphere. Helium is an inert gas and does not react with other substances or combust. It is the second lightest element after hydrogen.

Option 1: Hydrogen constitutes **0.000055%** of Earth's atmosphere. Hydrogen is used in industrial processes, as a rocket fuel, and in fuel cells for electricity generation.

So, the correct order is **Argon > Carbon dioxide > Helium > Hydrogen**

19. Solution: (d)

Exp) Option d is the correct answer.

Meteoroids are lumps of rock or iron that orbit the sun, just as planets, asteroids, and comets do. Meteoroids, especially the tiny particles called micrometeoroids, are extremely common throughout the solar system.

Mesosphere protects the Earth from meteoroids. It is the third layer of the atmosphere which lies **above the stratosphere.** The mesosphere extends from the stratopause (the upper boundary of the stratosphere) to about 85 kilometres (53 miles) above the surface of the Earth. **Meteorites burn up in this layer** on entering from the space. The mesosphere has the coldest temperatures in the atmosphere, dipping as low as -120 degrees Celsius (-184 degrees Fahrenheit, or 153 kelvin).

4.2. Temperature Distribution and Heat Budget

20. Solution: (d)

Exp) Option d is the correct answer.

Normally, temperature decreases with increase in elevation. It is called normal lapse rate. At times, the situation is reversed, and the normal lapse rate is inverted. It is called Inversion of temperature. Inversion is usually of short duration but quite common, nonetheless.

Statement 1 is correct: Inversion of temperature causes atmospheric stability which stops upward and downward movement of air. The atmospheric stability discourages rainfall and favours dry conditions.

Statement 2 is correct: It intensifies the process of formation of fog, as fog is formed due to the situation of warm air above and cold air below. Because the warm air is cooled from below and resultant condensation causes the formation of tiny droplets around suspended dust particles. Hence, dense fogs in mornings are common occurrences especially during winter season.

Statement 3 is correct: The inversion takes place in hills and mountains due to air drainage. Cold air at the hills and mountains, produced during night, flows under the influence of gravity. Being heavy and dense, the cold air acts almost like water and moves down the slope to pile up deeply in pockets and valley bottoms with warm air above. **This is called air drainage. It protects plants from frost damages.**

21. Solution: (b)

Exp) Option b is the correct answer.

Structures such as buildings, roads, and other infrastructure absorb and re-emit the sun's heat more than natural landscapes such as forests and water bodies. Urban areas, where these structures are highly concentrated, and greenery is limited, become "islands" of higher temperatures relative to outlying areas. These pockets of heat are referred to as "heat islands."

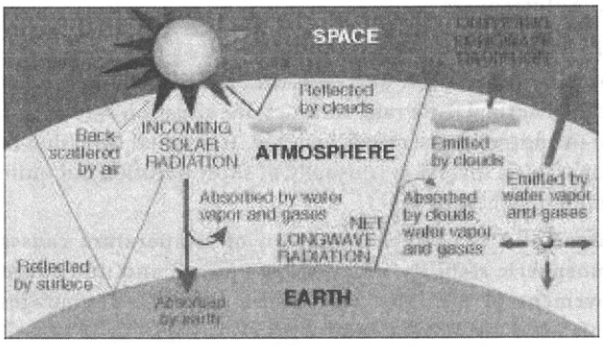
Statement 1 is correct: Calm and clear weather conditions result in more severe heat islands by maximizing the amount of solar energy reaching urban surfaces and minimizing the amount of heat that can be carried away.

Statement 2 is incorrect: Strong winds and cloud cover suppress heat island formation. Geographic features also impact the heat island effect such as nearby mountains can block wind from reaching a city or create wind patterns that pass through a city.

Statement 3 is correct: Conventional human-made materials used in urban environments such as **pavements or roofing tend to reflect less solar energy and absorb and emit more of the sun's heat** compared to trees, vegetation, and other natural surfaces. **Thus, low albedo value of concrete surfaces helps in the formation of Heat Islands in urban areas.** Often, heat islands build throughout the day and become more pronounced after sunset due to the slow release of heat from urban materials.

22. Solution: (c)

Exp) option c is the correct answer.



Statement 1 is incorrect. Solar energy enters our atmosphere as shortwave radiation in the form of ultraviolet UV rays and visible light. Earth's surface absorbs this short-wave radiation and re-emits the energy as long-wave radiation in the form of infrared rays.

Statement 2 is incorrect. It is estimated that of the total radiation coming to us, 35% is directly reflected to space by dust, clouds and air molecules. Another 14% is absorbed by water vapor, carbon dioxide and other gases. The remaining 51% reaches the earth and warms the surface.

Although the Earth maintains a balance between insolation and terrestrial radiation, we do not see this at all latitudes. The amount of insolation in the tropical zone is greater than the amount of terrestrial radiation.

23. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect: The earth-atmosphere energy balance is the balance between incoming energy from the Sun and outgoing energy from the Earth. Energy released from the Sun is **emitted as shortwave light and ultraviolet energy.** The earth's surface receives most of its energy in short wavelengths.

Statement 2 is correct: The amount and the intensity of insolation vary during a day, in a season and in a year. The factors that cause these variations in insolation includes the **angle of inclination of the sun's rays.** The fact that the earth's axis makes an angle of 66½ with the plane of its orbit round the sun has a greater influence on the amount of insolation received at different latitudes. The **higher the latitude the less is the angle they make with the surface of the earth resulting in slant sun rays.** The area covered by vertical rays is always less than the slant rays. If more area is covered, the energy gets distributed and the net energy received per unit area decreases. Moreover, the slant rays are required to pass through greater depth of the atmosphere resulting in more absorption, scattering and diffusion.

24. Solution: (a)

Exp) Option a is the correct answer.

Albedo is the **portion of solar energy reflected from the surface** of the Earth back into space.

It is a **reflection coefficient and has a value of less than one.**

Option a is correct.

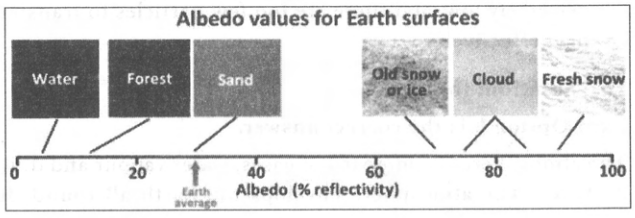
When solar radiation passes through the atmosphere, a certain amount of it is scattered, reflected and absorbed. The **reflected sum of radiation is called the albedo** of the earth.

Albedo is an important concept in climatology, astronomy, and environmental management.

It **plays a major role in the energy balance of the earth's surface**, as it **defines the rate of the absorbed portion of the incident solar radiation**

Different surfaces have different values.

Albedo is higher in Snow or Ice.



25. Solution: (c)

Exp) Option c is the correct answer.

The amount of insolation received on the earth's surface is not uniform everywhere. It varies from place to place and from time to time. The tropical zone receives the maximum annual insolation. It gradually decreases towards the poles. Insolation is more in summers and less in winters.

Statement 1 is correct: Maximum insolation is received over the subtropical deserts, where the cloudiness is the least. The cloudless skies allow for maximum insolation in the subtropical deserts as compare to other cloudy regions that reflects sunlight.

Statement 2 is incorrect: Equator receives **comparatively less insolation than the tropics due to presence of clouds.**

Statement 3 is correct: The **middle and higher latitudes receive less radiation in the winter season** than in the summer. Seasonal change has impact on insolation in this region, hence, dissimilarities are found in the amount of solar radiation.

Statement 4 is correct: At the equinoxes, solar insolation is at a maximum at the equator and is zero at the poles. At the summer solstice of the northern hemisphere, daily insolation reaches a maximum at the North Pole because of the 24-hour-long solar day. At the winter solstice, the sun does not rise above the horizon north of about 66.5°, where solar insolation is zero.

26. Solution: (d)

Exp) Option d is the correct answer.

Isotherms are imaginary lines drawn on maps in order to study the variations and distribution in temperature over various regions of the earth. Following are a few characteristics of Isotherms.

Statement 1 is correct: Isotherms are **imaginary lines** on a map **connecting points experiencing similar (Iso) temperature (Therm)** at a given point of time. Hence this statement is **correct.**

These lines help **understand the distribution and variation of temperature** in a region and make **predictions** regarding the weather there.

It is not to be confused with other types of imaginary lines such as those connecting places with similar atmospheric pressure (Isobars), sea water salinity (Isohaline), etc.

Statement 2 is incorrect: These lines are **generally parallel to lines of Latitude (not Longitude)** in both Hemispheres. Hence this statement is **incorrect.**

Latitudes determine the **angle at which sun rays fall on a particular place** on earth. Spots on Higher latitudes receive more slanted and hence less intense sun rays, and hence are cooler, and vice versa Hence **Latitude are closely correlated with the distribution of temperature** on earth, and hence by extension to **Isotherms** as they are the graphical representation of that temperature distribution. This is why Isotherms are generally parallel to lines of Latitude

Statement 3 is incorrect: Closely spaced isotherms indicate a **High Range (i.e., very steep rate of change, not gradual change) of temperature**. Hence this statement is **incorrect.**

If two isotherms are spaced closely, this means that **two places, very close by** to each other in **distance**, have **different types of temperatures**. This means that the **temperature has changed fast within a very short distance**. Hence the rate of change in temperature is steep not gradual (which would be represented by widely spaced isotherms).

27. Solution: (a)

Exp) Option a is the correct answer.

Temperature decreases with increasing altitudes in the troposphere at an average rate of 6.5°C per 1000 metres (normal lapse rate) but sometimes this normal trend of decrease of temperature with increasing heights is reversed under special circumstances i.e., temperature increases upward to a few kilometres from the earth's surface. This is called negative lapse rate. Thus, the warm air layer lies over the cold air layer. This phenomenon meteorologically is called inversion of temperature.

Statement 1 is correct: Having **colder, sinking air below the lighter, warmer, more mobile air**, results in very **stable conditions** where the **cold layer acts like a lid.** This lid-like layer **prevents any convective movements of particles below it**, effectively **trapping those things** near the earth surface. Thus, the normal process of convection (hot air rising to higher colder altitudes) is unable to occur. As the warm moisture bearing air is unable to rise to cooler upper layers and cool adiabatically to create condensation, rain bearing clouds (cumulonimbus and nimbus) are unable to form. This leads to **anticyclonic conditions** which are characterised by **aridity and lack of rainfall**. Hence this statement is **correct.**

Statement 2 is correct: As explained above, the **inversion creates a lid-like condition** near the earth's surface. This results in creation of **fog** (as the cold aids condensation of tiny suspended water droplets), while **preventing pollutants** emitted due to human activity during the day **from escaping** through convection currents at night. This **fog and pollutants combine** to form a **smog** that results in **poor air quality**, as is being seen in North India currently, especially in Delhi. This phenomenon is seen **mostly in winters** as Surface Inversion **occurs** only during **long winter nights with no winds**, as the earth heat gets radiated during the long winter night and the inverted layer is not disturbed in the absence of winds. Hence this statement is **correct.**

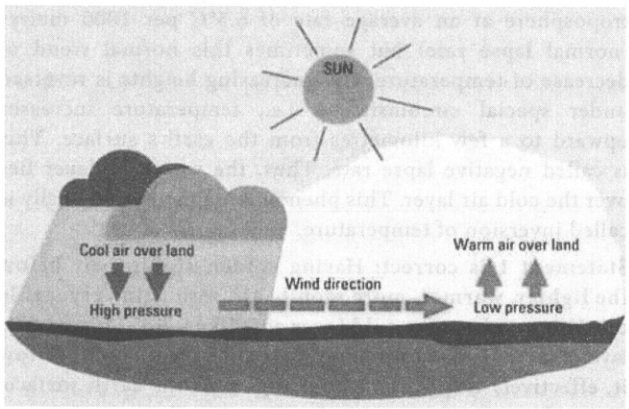
Statement 3 is correct and 4 is incorrect: In the **Valley Type of Temperature Inversion**, during the long, cold winter nights, the **earth's heat quickly escapes to higher altitudes** (nearer the mountain tops), while its place is **occupied by the cold air at the mountain tops** which being colder is heavier and hence **sinks to the valley bottom**. Thus, **valleys are colder** than the mountain tops. Also, the **valleys experience frost** in the **morning** due to the **lid-like effect**, and the **pollutants are also more heavily concentrated** in the valley region. Thus, the **people prefer to build settlements at mountain tops** (as there are fewer toxic pollutants). Hence this statement is **correct.**

Another effect of this phenomenon is that the **vegetation in the valley bottom generally dies** (due to the frost, while that on the mountain top thrives).

28. Solution: (c)

Exp) Option c is the correct answer.

The **Loo** is a strong, dusty, gusty, hot and dry summer wind from the west which blows over the Indo-Gangetic Plain region of North India. It is especially strong in the months of May and June. It is the outcome of **advection process**. Advection is a lateral or horizontal transfer of mass, heat, or other property. Accordingly, winds that blow across Earth's surface represent advectional movements of air.



Advectional Movements of Air

Advective winds move from areas of higher temperature toward areas of lower temperature. In contrast, convection, the vertical movement of mass or transfer of heat, manifests itself as air currents. Accordingly, winds are a result of advection, while air currents are a result of convection.

29. Solution: (a)

Exp) Option a is the correct answer.

Latitude is the measurement of the distance of a location on the Earth from the equator. The further away from the equator that you are the less sunlight that this location receives. More heat is lost to the atmosphere as the rays travel a longer distance through the atmosphere.

Statement 1 is correct: Latitude is one of the primary factors that affect temperature. As one moves further away from the equator, the temperature falls because regions receive less sunlight. The reason behind this is the shape of the earth. The shape of the earth is an oblate spheroid. Thus, not all locations receive the same amount of sunlight heat or insolation (Incoming Solar Radiation).

Statement 2 is incorrect: The atmosphere is indirectly heated by terrestrial radiation from below. Therefore, the places near the sea-level record higher temperature than the places situated at higher elevations. In other words, the **temperature generally decreases with increasing height.**

Statement 3 is incorrect: Another factor that influences the temperature is the location of a place with respect to the sea. Compared to land, the sea gets heated slowly and loses heat slowly. Land heats up and cools down quickly. Therefore, **the variation in temperature over the sea is less compared to land.** The places situated near the sea come under the moderating influence of the sea and land breezes which moderate the temperature.

Important Tips

The oblique sunrays become more and more slanting when it reaches from the equator towards the poles. And temperature also decreases poleward. But **the highest temperature is not located in equator but at the subtropical high pressure belt**. The reason being Rainfall and Cloud cover throughout the year at equator.

30. Solution: (a)

Exp) Option a is the correct answer.

The Heat Budget of Earth is a concept that deals with the amount of heat energy received from the sun and its utilization in the atmosphere and the surface of the earth. It explains why the earth neither warms up nor cools down despite the huge transfer of heat that takes place.

Statement 1 is correct: Terrestrial radiation is a part of the **Earth's radiation budget and helps in heating the bottom section of the atmosphere.** The Earth's radiation budget represents the accounting of the balance between incoming radiation, which is almost entirely solar radiation, and outgoing radiation, which is partly reflected solar radiation and partly radiation emitted from the Earth system, including the atmosphere.

Statement 2 is incorrect: Let us Consider that the solar insolation or incoming solar radiation received at the top of the atmosphere is 100 per cent. While passing through the atmosphere some amount of energy is reflected, scattered and absorbed. Only around 14% (not more than 50%) of the incoming solar radiation is absorbed by Earth's atmosphere.

31. Solution: (a)

Exp) Option a is the correct answer.

Isotherms are lines that connect points of equal temperature on a map. The horizontal distribution of temperature on Earth is shown by isotherms.

Statement I is correct: During winter in the northern hemisphere, the **isotherms shift towards the south over the continent and towards the north over the ocean**. This is because the landmasses in the Northern Hemisphere cool down more rapidly than the oceans, which retain heat for a longer time. As a result, the temperature gradient over the continents is steeper than over the oceans, causing the isotherms to bend towards the equator over the continents.

Statement II provides an explanation for the phenomenon described in Statement I. Land has low thermal capacity and limited heat transfer capacity than the water. The fact that landmasses cool down more rapidly than oceans during winter directly relates to the observed shifting of isotherms towards the south over continents and towards the north over oceans.

32. Solution: (c)

Exp) Option c is the correct answer.

Temperature inversion is a meteorological phenomenon occurring when the atmosphere's temperature increases with altitude, as opposed to the normal decrease in temperature with altitude. This phenomenon is caused by the trapping of cool air near the ground surface by a layer of warm air above it

Option 1 is correct: Longer nights during winter **provide more time for the Earth's surface to cool** through radiative heat loss, contributing to the development of temperature inversions.

Option 2 is correct: Clear and cloudless conditions allow for **efficient radiative cooling of the Earth's surface during nighttime**, aiding in the cooling of the air near the ground and contributing to the development of temperature inversions.

Option 3 is incorrect: Low-pressure weather systems typically bring unsettled weather conditions with rising air masses, promoting vertical mixing and hindering the formation of temperature inversions. Therefore, **low-pressure systems are not favorable for the development of temperature inversions**. On the contrary, High-pressure systems can lead to calm winds and reduced atmospheric turbulence, aiding in the formation and maintenance of inversions.

Option 4 is correct: Dry air near the ground surface can **enhance the cooling effect of the Earth's surface during clear nights,** aiding in the development of temperature inversions.

33. Solution: (c)

Exp) Option c is the correct answer.

The amount and the intensity of insolation vary during a day, in a season and in a year. The factors that cause these variations in insolation are:

Option 1 is correct: The Earth rotates on its own axis, which makes an angle of 66.5 degrees with the plane of its orbit around the sun. This **rotation causes the sun's rays to strike the Earth's surface at different angles at different times of the day**, leading to variations in insolation.

Option 2 is correct: The amount of insolation received at the surface depends on the length of the day. The **longer the day, the more exposure an area on the Earth's surface has to solar energy, and thus, the higher insolation is received.** Conversely, shortening the day's duration results in less insolation.

Option 3 is incorrect: Ocean currents and circulation systems **do not directly influence the amount of insolation received on the Earth's surface.** Ocean currents and circulation systems play a significant role in redistributing heat around the globe.

Option 4 is correct: Atmospheric conditions, including factors like cloud cover, dust, and other particles, **affect the transmission of solar radiation to the Earth's surface**. The transparency or opacity of the atmosphere influences the amount of insolation reaching the surface.

Option 5 is correct: The orientation or aspect of land surfaces influences the absorption and reflection of solar radiation. Surfaces **oriented more directly toward the Sun receive higher insolation** compared to surfaces with oblique angles relative to the Sun.

34. Solution: (a)

Exp) Option a is the correct answer.

Statement-I is correct: The presence of large and deep lakes exercise a significant effect in moderating the climate of a surrounding region. Similar to how oceans influence nearby land masses, these lakes affect the climate by heating up more slowly during the day and cooling down more slowly at night compared to the adjacent land. For instance, the **eastern shores of Lakes Erie, Ontario, and Huron experience milder winters than their western counterparts**, as the breezes blowing from the lakes are warmed, reducing the occurrence of early frosts.

Statement-II is correct and explains the Statement-I: Water has a higher specific heat than land, meaning it can absorb and retain more heat energy per unit mass. This property causes water to heat and cool more slowly than land. As a result, coastal areas experience milder temperature variations compared to inland regions, influencing climate patterns.

In summer, **water absorbs more heat than land because of its higher specific heat capacity**. Conversely, in winter, water releases heat more slowly than land for the same reason. Water also is fluid, allowing the heat to be mixed to greater depth than on land. The heat capacity is the product of the specific heat and the mass (in g) of the material. This discrepancy in heat absorption and release leads to a moderation of the climate in surrounding regions due to differential heating and cooling of land and water.

35. Solution: (c)

Exp) Option c is the correct answer.

The troposphere is indirectly heated by terrestrial radiation from below. So, the temperature generally decreases with increasing height. **The rate of decrease of temperature with height is termed as the normal lapse rate. It is 6.5°C per 1,000 m.**

Statement 1 is correct. The Normal Lapse Rate is never constant. It **varies from place to place and from season to season.**

At a particular location, **the Normal Lapse Rate is usually higher in the summer season as compared to the winter.**

For example, in temperate latitudes, the **Normal Lapse Rate in Summer is 1 degree Fahrenheit per 280 feet. However, in winter,** the **Normal Lapse Rate drops to 1 degree Fahrenheit per 400 feet.**

Statement 2 is correct. It is true that at a particular location, **the Normal Lapse Rate is usually higher by days than at nights.**

36. Solution: (a)

Exp) Option a is the correct answer.

Statement-I is correct: Hot deserts, such as the Sahara and the Thar, **experience extreme temperature variations between day and night. During the day, temperatures can**

soar above 40°C, while at night, they may drop drastically to near freezing. This large difference between daytime and nighttime temperatures is referred to as the diurnal temperature range and is a characteristic feature of desert climates.

Statement-II is correct: Hot deserts generally have very **low humidity and minimal cloud cover due to the descending dry air associated with subtropical high-pressure systems.**

Statement III is correct:Dry air has a lower heat capacity than moist air, meaning it heats up quickly during the day under direct sunlight and cools rapidly at night due to radiational cooling.

Statement-II explains Statement-I: Clear, cloudless skies in hot deserts directly contribute to the large diurnal temperature range. During the day, the absence of clouds allows the sun's radiation to intensely heat the ground. At night, without clouds to trap heat, the ground rapidly radiates its warmth back into the atmosphere, leading to significant cooling. **This rapid heating and cooling cycle, facilitated by the consistent clear skies, results in the very great difference between daytime highs and nighttime lows, which defines the diurnal temperature range.**

Statement-III explains Statement-I:Dry air has a lower heat capacity than moist air, meaning it requires less energy. During the day, the dry desert air rapidly absorbs solar radiation, leading to a quick and substantial increase in temperature. Conversely, at night, this same dry air loses heat just as quickly, resulting in a significant drop in temperature. This rapid heating and cooling cycle, due to the low heat capacity of dry air, is a key factor in the large temperature fluctuations observed in hot deserts.In deserts, where the air is extremely dry, this effect is more pronounced, leading to sharp temperature fluctuations between day and night.

37. Solution: (c)

Exp) Option c is the correct answer.

Statement I is correct. Radiation from the sun heats up Earth's landmasses and oceans. **It takes less energy to change the temperature of land compared to water. This means that land heats and cools** more quickly than water. Thus, with a given amount of solar irradiation, landmasses get heated up more quickly than the oceans.

Statement II is correct and explains statement I. The opaqueness of water is less than that of land. It also means that water is more transparent to solar radiation than land. **Therefore, radiation is able to penetrate deeper into water** and distributes the energy more evenly. Solar radiation only reaches a few centimeters into land while, depending on the clarity, solar radiation can reach several meters into water. The result is that **a greater volume of water is heated thus resulting in a slower rate.** The smaller volume of land however attains higher temperatures.

Statement III is incorrect. Land heats up more quickly than oceans. This is because land has a smaller "specific heat capacity" than water, which means it needs less heat to raise its temperature. Water has a much higher heat capacity, or specific heat, than do sands, soils or other materials, for a given amount of solar irradiation (insolation).

Specific heat capacity is defined as the heat required to increase one unit temperature of a unit mass of a substance. It can termed as the amount of heat needed to raise the temperature of 1 gram of a substance by 1 degree Celsius (°C).

38. Solution: (a)

Exp) Option a is the correct answer.

Statement-I is correct: The Earth receives almost all of its energy from the sun. However, the **Earth maintains a constant average temperature** due to a balance between the energy it receives from the Sun and the energy it radiates back into space.

Statement-II is correct and is the correct explanation of Statement-I: The Earth's temperature stability is largely due to this energy balance. The incoming solar radiation is balanced by outgoing radiation. If this balance were significantly disrupted, the Earth's temperature would change.

If insolation received at the top of the atmosphere is 100 percent, 35 units are reflected back to space even before reaching the Earth's surface. The remaining 65 units are absorbed, 14 units within the atmosphere and 51 units by the earth's surface. The earth radiates back 51 units in the form of terrestrial radiation. Of these, **17 units are radiated to space directly and the remaining 34 units are absorbed by the atmosphere.** The units absorbed by the atmosphere are also radiated back into space. Thus, the **earth neither warms up nor cools down despite the huge transfer of heat that takes place.** This is referred to as the heat budget or heat balance of the Earth.

39. Solution: (c)

Exp) Option c is the correct answer.

Statement I is correct: During winter, the temperature generally decreases significantly compared to summer months due to the Earth's tilt away from the sun, resulting in less direct sunlight and therefore lower temperatures.

Statement II is correct and explains Statement I: During winter, the Northern Hemisphere is tilted away from the sun. This has two main effects:

1. Sunlight strikes the Northern Hemisphere at a shallower angle, spreading the same amount of solar energy over a larger area. This reduces the intensity of the sunlight and its heating effect.
2. The tilt also contributes to the shorter days and longer nights, further limiting the amount of solar radiation received.

Winter days are significantly shorter than summer days, meaning the Northern Hemisphere receives less direct solar radiation. This shorter period of sunlight limits the amount of heat energy the Earth can absorb.

Statement III is incorrect: The **Earth's seasons are primarily caused by the tilt of its axis, not its distance**

from the sun. While the Earth's orbit is elliptical, the variation in distance between aphelion (farthest from the sun) and perihelion (closest to the sun) has a minimal impact on seasonal temperature changes. In fact, the **Earth is at aphelion during the Northern Hemisphere's summer and at perihelion during its winter.**

40. Solution: (b)

Exp) Option b is the correct answer.

The **amount of insolation received on the earth's surface is not uniform everywhere.** It varies from place to place and from time to time.

Statement 1 is incorrect: The insolation received at the surface varies from about 320 Watt/m2 in the tropics to about 70 Watt/m2 in the poles. While **it is true that the equator receives more direct sunlight compared to the poles, the actual difference in insolation is not as large as a hundred times.** The difference in insolation between the equator and poles is primarily due to the curvature of the Earth and the tilt of its axis, resulting in varying angles at which sunlight reaches different latitudes.

Statement 2 is correct: As transparency of the atmosphere also determines the amount of insolation reaching the earth's surface. Over oceans generally the cloud cover is higher due to greater water availability for evaporation. Thick clouds hinder the insolation to reach the earth while clear sky helps it to reach the surface. Thus, **generally at the same latitude the insolation is more over the continent than over the oceans.**

Statement 3 is incorrect: The **sub-tropical high-pressure belt areas generally experience clear skies and dry conditions, leading to high insolation.** These areas are not characterized by dense cloud cover, which would block sunlight.

41. Solution: (c)

Exp) Option c is the correct answer.

The temperature of air at any place is influenced by several factors including the latitude of the place, the altitude of the place, distance from the sea, the air-mass circulation, the presence of warm and cold ocean currents and some local aspects.

Option 1 is correct: The temperature of a place is influenced by the location of a place with respect to the sea. **Compared to land, the sea gets heated slowly and loses heat slowly.** Land heats up and cools down quickly. Therefore, **the variation in temperature over the sea is less compared to land.** The places situated near the sea come under the moderating influence of the sea and land breezes which moderate the temperature.

Option 2 is correct: The temperature of a place depends on the insolation received. The **insolation varies according to the latitude** hence the temperature also varies accordingly. Thus, **places closer to the equator (lower latitudes) experience warmer temperatures** compared to places farther from the equator (higher latitudes).

Option 3 is correct: The atmosphere is indirectly heated by terrestrial radiation (emitted from earth). Therefore, the **places near the sea level record higher temperatures than the places situated at higher elevations.** In other words, the temperature generally decreases with increasing height.

Option 4 is incorrect: The **temperature of a place is not determined directly by the longitude of a place.**

42. Solution: (c)

Exp) Option c is the correct answer.

Radiation from the sun heats up Earth's landmasses and oceans. The heating and cooling differences of land and water affect the temperature and movement of air masses above the land and water.

Statement I is correct: The land heats up and cools down much faster than oceans. Land surfaces respond more rapidly to changes in solar radiation because they have a lower heat capacity compared to water. Land absorbs heat quickly during the day and releases it quickly at night. In contrast, water takes longer to heat up due to its higher heat capacity, and it retains heat longer, causing it to cool more slowly.

Statement II is incorrect: The specific heat of land is lower than that of water. Specific heat is the amount of heat energy required to raise the temperature of a substance by a certain amount. **Water has a relatively high specific heat compared to land surfaces. This means that it takes a larger amount of heat energy to raise the temperature of water** compared to an equal mass of land surface material by the same amount. This property of water causes it to warm and cool at a slower rate than land, leading to more stable temperatures over oceans and coastal regions.

43. Solution: (a)

Exp) Option a is the correct answer.

Temperature inversion is a meteorological phenomenon where the normal lapse rate, in which temperature decreases with elevation, is reversed. Instead, cooler air is trapped near the ground, while warmer air remains above it.

Statement I is correct: Temperature inversion is a common phenomenon in polar areas throughout the year due to the extremely cold surface conditions.

Statement II is correct and explains statement I: In polar regions, the combination of persistent cold and minimal solar heating results in the surface cooling more quickly than the air above, causing temperature inversion. **This is why inversion is a common occurrence in polar regions.**

44. Solution: (d)

Exp) Option d is the correct answer.

Albedo is a measure of the reflectivity of a surface, with higher values indicating greater reflection of solar radiation. Among the given options, **snow** has the highest albedo, ranging from **0.7 to 0.9**, meaning it reflects **70-90%** of incoming sunlight.

Albedo of Earth Materials

Substance	Albedo (% reflectance)
Whole Planet	0.31
Cumulonimbus Clouds	0.9
Stratocumulus Clouds	0.6
Cirrus Clouds	0.5
Water	0.06 - 0.1
Ice & Snow	0.7 - 0.9
Sand	0.35
Grass lands	0.18 - 0.25
Deciduous forest	0.15 - 0.18
Coniferous forest	0.09 - 0.15
Rain forest	0.07 - 0.15

45. Solution: (b)

Exp) Option b is the correct answer.

A heat budget refers to the balance between incoming heat absorbed by earth and outgoing heat escaping it in the form of radiation.

The Earth's temperature remains stable over long periods of time. This is because the earth receives almost all of its energy from the sun and in turn **radiates back to space the energy received from the sun.** This is termed as **heat budget or heat balance** of the earth. Thus, the amount of heat received by different parts of the earth is not the same. This variation causes pressure differences in the atmosphere. This leads to transfer of heat from one region to the other by winds.

The oceans do absorb most of the excess heat from greenhouse gas emissions. However, this is not the correct reason for earth to maintain the heat balance. The absorption of greenhouse gases by oceans has led to rise in ocean temperatures.

46. Solution: (c)

Exp) Option c is the correct answer.

There are **different ways of heating and cooling of the atmosphere like conduction, convection and advection.** The earth after **being heated by insolation transmits the heat** to the atmospheric layers **near to the earth in long wave form**.

Statement 1 is correct: Advection refers to the **horizontal movement of air**, **parallel** to the **surface of the earth.** Advection is the main mechanism of heat redistribution in the middle latitudes.

These winds blow from a region of **high pressure (cooler) to low pressure (hotter)**. This helps **dissipate** some of the heat and **affects the diurnal variation of temperature.** This effect of advection on diurnal temperature ranges is **most pronounced in the mid latitudes.**

Statement 2 is correct: Heat within the earth's atmosphere is also transferred through the process of **convection**. In this **air, over** intensely **heated areas expand** and **becomes less dense** and **rises up**, thus **transferring heat from lower layers to the upper layers** which are cooler. However, these convective currents are **seen only within the first layer** of the atmosphere, i.e., the **Troposphere**. The **Tropopause (last limit** of **troposphere**, about **10-12 km above earth surface**) acts as a **lid** and **prevents** any **convective currents** from going beyond to the **next layer of atmosphere, i.e., Stratosphere.** This happens **because of** the **temperature inversion** that occurs **at tropopause.**

47. Solution: (a)

Exp) Option a is the correct answer.

The Earth's axis of rotation is tilted at an angle of 23.5° to its orbital plane. This tilt — combined with factors such as Earth's spin and orbit — leads to variations in the duration of sunlight that any location on the planet receives on different days of the year.

Amount of daylight hours depends on our latitude. These latitudes, are a measure of a location's distance from the Equator.

Option a is correct. Paramaribo is the capital city of Suriname on the banks of the Suriname River. It is near to Equator and its latitude is 5.8° N.

San Salvador is the capital and the largest city of El Salvador. It is the country's political, cultural, educational and financial center. It is near to Equator and its latitude is 13.7° N.

Malta is an archipelago in the central Mediterranean between Sicily and the North African coast. Its latitude is 35.9° N.

Lisbon is hilly, coastal capital city of Portugal. Its latitude is 38.7° N.

Hence the duration of day in these cities will be in this order- **Paramaribo>San Salvador>Malta > Lisbon**

4.3. Pressure Belts and Systems

48. Solution: (c)

Exp) Option c is the correct answer.

Wind is the bulk movement of air that either result from temperature difference, largescale synoptic pressure, or local pressure and temperature differences. When these winds occur in the mountainous region they are called as mountain winds. There are two types of winds, anabatic and katabatic winds.

Statement 1 is incorrect: An anabatic wind is warm wind that blows up a mountain slope due to a warmer temperature on the mountain slope compared to the temperature in the air column. Also known as an upslope wind or upslope flow. This type of wind usually occurs on a clear sunny day. The opposite of an anabatic wind is a katabatic wind, which blows down the slope of a mountain. Additionally, katabatic winds blow at night and are caused by reversed temperature differences between the air column and the mountain slope.

Statement 2 is correct: The examples of katabatic winds include bora winds of the Adriatic, Oroshi winds of Japan, and Piteraq winds in Greenland.

Statement 3 is correct: Katabatic winds most commonly blow out from large, elevated ice sheets in Greenland and

Antarctica regions. The high-density cold air that builds up over the ice sheet and the elevation of the ice sheet increases the force of gravity. When these winds are concentrated in a restricted area, they will blow with hurricane speed. **In some areas, especially in Antarctica, the snow may be scoured away by the force of these winds, leading to the formation of Antarctica oases.**

The areas where, during the summer season, much of the snow melts away, revealing Antarctica's rock surface. They are dotted with freshwater lakes of various sizes, which become ice-free in the summer. It is these areas that are known as **Antarctic oases.**

49. Solution: (b)

Exp) Option b is the correct answer.

Several laws effect the movement of wind and geographical systems in the planet and solar system. Ferrel's law is one among them.

Option b is correct - According to the Ferrel's Law, If a body moves in any direction on the earth's surface, there is a deflecting force arising from the earth's rotation, which deflects it to the right in the northern hemisphere and to the left in the southern hemisphere. It causes an apparent deflection of the path of an object that moves within a rotating coordinate system.

50. Solution: (d)

Exp) Option d is the correct answer.

The air in motion is called wind. Wind is moving air and is caused by differences in air pressure within our atmosphere. Air under high pressure moves toward areas of low pressure. The greater the difference in pressure, the faster the air flows.

Statement 1 is correct: The differences in atmospheric pressure produce a force. **The rate of change of pressure with respect to distance is the pressure gradient**. The pressure gradient is strong where the isobars are close to each other and are weak where the isobars are apart. The **speed of the wind is directly proportional to the pressure gradient force,** meaning that as the change in pressure increases (i.e. pressure gradient increases) the speed of the wind also increases at that location.

Statement 2 is correct: The **friction force on the wind is more at the land surface** than on the sea surface. The Frictional Force is **greatest at the surface** and its influence generally extends up to an elevation of 1 – 3 km. Over the sea surface the friction is minimal. Over uneven terrain, however, **due to high friction, the wind direction makes high angles with isobars and the speed gets retarded.**

Statement 3 is correct: The **rotation of Earth on its axis causes winds to shift direction, creating what are called the prevailing winds**. This wind shift, **known as the Coriolis effect**, causes winds in the Northern Hemisphere to shift to the right and winds in the Southern Hemisphere to shift to the left.

51. Solution: (c)

Exp) Option c is the correct answer.

The latitudinal distribution of atmospheric pressure is also known as horizontal distribution of atmospheric pressure. It is characterized by low- and high-pressure belts. There are mainly seven pressure belts on the earth.

Option a is correct: The **sub-tropical high-pressure** belts are located between latitudes 25° to 35° in both hemispheres. In the northern hemisphere it is called the North sub-tropical high-pressure belt and in the southern hemisphere it is known as South sub-tropical high-pressure belt. **The high-pressure belt in these latitudes is because of the settling down of winds that arose in the equatorial region and got deflected towards poles due to the earth's rotation.**

Option b is correct: Hot deserts are mainly found around the Tropics of Cancer and Capricorn. The hot deserts of the world are located between 15° and 30° north or south of the equator, where the air is subsiding or sinking air. **The hot deserts lie along the Horse Latitudes or the Sub-Tropical High-Pressure Belts where the air is descending**, a condition least favorable for precipitation of any kind to take place. The rain-bearing Trade Winds blow off-shore and the Westerlies that are on-shore blow outside the desert limits.

Option c is incorrect: The **Equatorial Low-Pressure Belt** is located in the vicinity of the equator between 5° N and 5° S latitudes. The equatorial trough of low pressure is the zone of convergence of trade winds blowing equator wards from the sub-tropical belts of high pressure in the northern and southern hemispheres. As these regions receive vertical rays of the sun the ground gets heated cause air to rise upwards creating a low pressure along the ground. **That is why these belts are called the Doldrums.** Whereas the latitudes of sub-tropical high-pressure belts are called **horse latitudes.**

Option d is correct: The **sub-tropical high-pressure** belts have a convergence zone at higher altitudes which when subsides, causes piling up of air and reduction of volume thus resulting in high pressure. Thus, anticyclonic conditions develop which results in **calm and arid weather.**

52. Solution: (d)

Exp) option d is the correct answer.

Option a is incorrect: Local winds - Local Winds are a natural phenomenon that can be observed in many parts of the world. It is created when air moving over a geographic feature such as a mountain or body of water is forced to rise and then falls. The high-pressure air at the top of the hill (or over the water) causes the air at the bottom to rush out and create local winds.

Option b is incorrect: The Intertropical Convergence Zone- ITCZ is the region that circles the Earth, near the equator, where the trade winds of the Northern and Southern Hemispheres come together. The intense sun and warm water of the equator heats the air in the ITCZ, raising its humidity and making it buoyant.

Option c is incorrect: - A front is a weather system that is the boundary separating two different types of large air bodies. One type of air is usually denser than the other, with different temperatures and different levels of humidity. This

clashing of air types causes weather: rain, snow, cold days, hot days, and windy days.

Option d is correct: Air mass is large body of air having nearly uniform conditions of temperature and humidity at any given level of altitude. Such a mass has distinct boundaries and may extend hundreds or thousands of kilometres horizontally and sometimes as high as the top of the troposphere (about 10–18 km [6–11 miles] above the Earth's surface). An air mass forms whenever the atmosphere remains in contact with a large, relatively uniform land or sea surface for a time sufficiently long to acquire the temperature and moisture properties of that surface. The Earth's major air masses originate in polar or subtropical latitudes.

53. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: ITCZ exists because of the convergence of the trade winds. In the northern hemisphere the northeast trade winds converge with southeast winds from the Southern Hemisphere. The point at which the trade winds converge forces the air up into the atmosphere, forming the ITCZ.

Statement 2 is correct: The Intertropical Convergence Zone, or ITCZ, is the region that circles the Earth, near the equator, where the trade winds of the Northern and Southern Hemispheres come together. The intense sun and warm water of the equator heats the air in the ITCZ, raising its humidity and making it buoyant. Aided by the convergence of the trade winds, the buoyant air rises. **As the air rises it expands and cools, releasing the accumulated moisture in an almost perpetual series of thunderstorms.**

54. Solution: (c)

Exp) Option c is the correct answer.

Tornadoes are violently spinning, funnel-shaped columns of air that extend from the dark thunderclouds (bottom layer of the sky where they form) to the ground. Tornadoes are also known as twisters. The wind from a tornado can be more than 250 Km/Hour. Tornadoes occur all over the planet, but the United States leads the world in the number of storms followed by Argentina and Bangladesh. Some tornadoes are clearly visible, while rain or nearby low-hanging clouds obscure others. Tornadoes develop extremely rapidly, and may dissipate just a quickly. Most tornadoes are on the ground for less than 15 minutes.

55. Solution: (c)

Exp) Option c is the correct answer.

Many local winds are common around the Mediterranean Sea due to the varied topography of the region. The various local wind around the Mediterranean Sea are as follows:

1) **Sirocco:** This is a hot, dry, dusty wind which originates in the Sahara Desert. It blows outward from the desert interior to the cooler Mediterranean Sea. It is known by different local names such as Chili in Tunisia, Ghibli in Libya, Leveche in Spain, and Khamsin in Egypt and Malta. In Adriatic & Aegean Sea, this hot wind is known as Gharbi. Hence, option 1 is correct.
2) **Bora Wind:** It is Cold north-easterly wind experienced along the Adriatic. It is caused by a difference in pressure between continental Europe & Mediterranean. Bora wind is more violent than the Mistral & speeds of over 100 mph have been recorded. Hence, option 3 is correct.
3) **Mistral Wind:** The mistral is a strong, cold, northwesterly wind that blows from southern France into the Gulf of Lion in the northern Mediterranean. Hence, option 5 is correct.
4) Fohn wind: Fohn is experienced in the valleys of northern Alps, particularly in Switzerland in spring.

Option 2 is incorrect: Nor wester/ Kalbaishakhi wind: During the pre-monsoon season, the eastern and north-eastern state of **India** experience the appearance of a special type thunderstorm known as nor-wester.

Option 4 is incorrect: The Santa Ana winds are strong, extremely dry downslope winds that originate inland and affect coastal California in **USA.**

56. Solution: (c)

Exp) Option c is the correct answer.

Rossby waves, also known as planetary waves, naturally occur in rotating fluids. Within the Earth's ocean and atmosphere, these waves form as a result of the rotation of the planet.

Statement 1 is correct. The twin tropical cyclones are caused by **equatorial Rossby waves.** The twin cyclone is a vortex (circulation with a definable centre) in the northern hemisphere and another in the southern hemisphere, and each of these is a mirror image of the other. It is formed when **vortex in the north spins counter clockwise** and has a positive spin, while the **one in the southern hemisphere spins in the clockwise direction** and therefore has a negative spin. Both have positive value of the vorticity which is a measure of the rotation. Hence resulting in formation of twin cyclones.

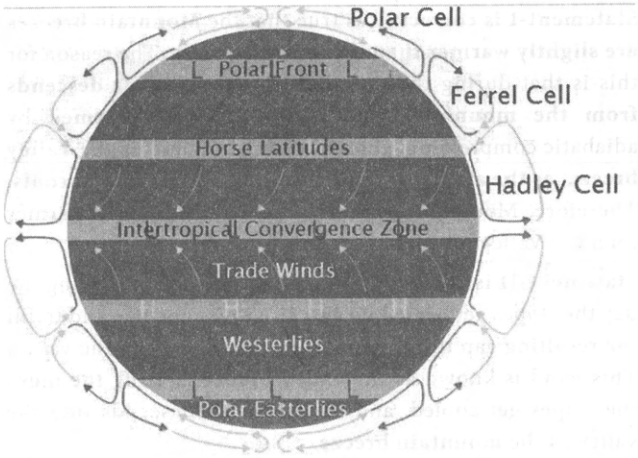
Statement 2 is correct. Rossby waves formed in atmosphere help **transfer heat from the tropics toward the poles and cold air toward the tropics** in an attempt to return atmosphere to balance. This also help in locating the jet stream (narrow bands of strong wind in the upper levels of the atmosphere) and mark out the track of surface low pressure systems. The slow motion of these waves even results in fairly long, persistent weather patterns.

57. Solution: (c)

Exp) Option c is the correct answer.

The planetary winds are permanent winds which blow throughout the year from low latitude to the other in response to the latitudinal differences in air pressure. The two most significant winds for climate and human activities are the trade winds and the westerly winds.

Statement 1 is correct. The westerlies blow from 35-40 degree to 60-65 degree North and South latitude. They originate in the **northern parts of sub-tropical high-pressure cells and blow toward the poles.**



Statement 2 is incorrect. The **horse latitudes** are regions located **at about 30 degrees north and south** of the equator. These latitudes are characterized by **calm winds and little precipitation.** In this region of the subtropics, winds diverge and either flow toward the poles (known as the prevailing westerlies) or toward the equator (known as the trade winds). These diverging winds are the result of an area of high pressure, which is characterized by calm winds, sunny skies, and little or no precipitation.

Statement 3 is correct. The westerlies of the **southern hemisphere are stronger and persistent** due to the vast expanse of water, while those of the northern hemisphere are irregular because of uneven relief of vast land-masses.

58. Solution: (c)

Exp) Option c is the correct answer.

A circumpolar vortex, or simply polar vortex, is a large region of cold, rotating air that encircles both of Earth's polar regions.

Statement 1 is incorrect. Polar vortex is described as a whirling cone of **low pressure** over the poles.

Statement 2 is incorrect. Normally, when the vortex is strong and healthy, it helps to keep a current of air (the jet stream) travelling around the globe in almost a circular path. This current keeps the cold air up north and warm air down south. **When the vortex becomes weak there is a lack of a strong low-pressure system, resulting in jet stream losing the hold to keep it in line, and becoming wavy and all of a sudden, a river of cold air is pushed down south.**

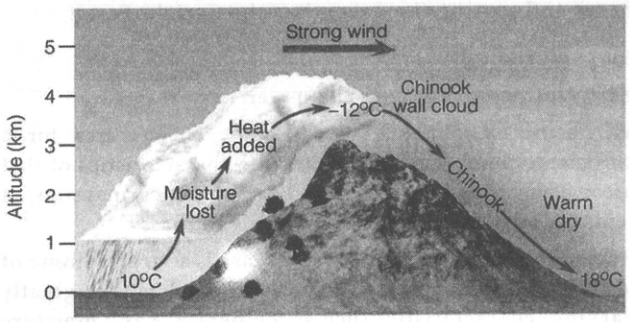
Statement 3 is correct. The term vortex refers to counterclockwise flow of air that keeps the colder air near the poles.

59. Solution: (d)

Exp) Option d is the correct answer.

Foehn or Chinook is a type of periodic wind that changes direction periodically with change in season.

Statement 1 and 2 are correct. Chinook winds is a hot dry wind that blows in winter on leeward side of mountain. It blows **east of the Rocky Mountains in Canada** and the **United States.** Chinook's literal meaning is 'snow eater,' as they aid in the melting of snow.

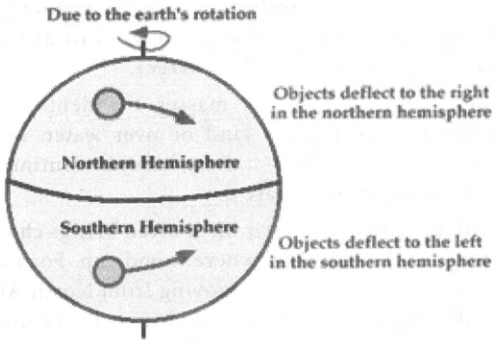


Statement 3 is correct. The temperature of the wind varies between 15°C and 20°C that helps animal grazing by melting snow and aids to the suitability for the **ripening of grapes.**

60. Solution: (a)

Exp) Option a is the correct answer.

The Coriolis Force is a pseudo force that causes objects travelling over great distances to deflect from their original path (to the right in the Northern Hemisphere and to the Left in the Southern Hemisphere). It is a result of the Rotation of Earth on its Axis.



Statement 1 is correct: Coriolis Force is a **geophysical phenomenon** responsible for the **deflection** in the **direction of flow of fluid systems (winds and ocean currents)** on earth surface.

Statement 2 is correct: The Coriolis force acts in a direction perpendicular to the angular velocity of the rotating frame.

Statement 3 is correct: The Coriolis Force is **directly proportional to the angle of latitude.** As the **latitude** at which horizontally and freely moving objects are located **increases,** the **twisting of the underlying Earth's surface** and its **velocity** due to the planet's rotation **increases.** Hence the Coriolis Force is **maximum** at the **Poles** and **almost absent at the Equator.**

Statement 4 is incorrect: The **Coriolis Force** is **dependent on following factors**

1) The Velocity of the object travelling over great distances across the latitudes on earth relative to the Velocity of the earth.
2) The Latitude at which the travelling object is originating. (Sine of the angle of the latitude)

3) The mass of the moving body.

Hence this statement is **incorrect** as **Latitude is not the sole factor influencing the strength** of the Coriolis Force.

61. Solution: (b)

Exp) Option b is the correct answer.

When the air remains over a homogeneous area for a sufficiently long time, it acquires the characteristics of that area. The air with distinctive characteristics in terms of temperature and humidity is called an air mass.

Statement 1 is incorrect: An **Air Mass** is a **large volume of atmospheric air** that has **almost homogenous (not greatly varying) characteristics** such as **temperature and moisture** throughout a significant horizontal distance. Hence this statement is **incorrect.**

Also, it must be noted that the **homogeneity** in characteristics **typically extends horizontally** and **not vertically.**

A **mass of air** wherein there is a **great variation in temperature and moisture** is known as a **"Front"**. It is typically the **narrow region** where **two different types of air masses meet**.

Statement 2 is correct: For the Air Mass to form, a **large volume of air** needs to lie **undisturbed** over a piece of land or water, for **long periods of time**, so that it **can absorb** the temperature, etc of the **underlying source region**. This is possible only when there is **low or no wind to disturb** this air mass. Hence this statement is **correct.**

Statement 3 is incorrect: Air masses are identified based on whether they form over land or over water. Maritime air masses form over water and are humid. Continental air masses form over land and are dry.

Statement 4 is correct: An Air Mass **often brings changes to the weather** in **destinations** where it ends up. For example, a tropical continental air mass moving from North Africa to Europe will bring dry and warm conditions to the otherwise cold climate over there. Similarly, when two different types of air masses, such as warm and humid and cold and dry meet, it gives rise to a Front where a rapid change in temperature, humidity, etc gives rise to storm like conditions. Hence this statement is **correct.**

Important Tips

a) Air masses can extend thousands of kilometres across the surface of Earth, and can reach from ground level to the stratosphere—16 kilometres (10 miles) into the atmosphere.

b) Following types of air masses are recognised: (i) Maritime tropical (mT); (ii) Continental tropical (cT); (iii) Maritime polar (mP); (iv) Continental polar (cP); (v) Continental arctic (cA). Tropical air masses are warm and polar air masses are cold.

62. Solution: (b)

Exp) Option b is the correct answer.

Mountain and valley breezes are local wind patterns influenced by temperature variations between mountains and adjacent valleys.

Statement-I is correct: It is true that the **Mountain breezes are slightly warmer than the Valley breezes.** The reason for this is that during the **mountain breeze, the air descends from the mountain,** gets compressed and **warmed** by adiabatic compression. On the other hand, during the **Valley breeze, as the air rises from the valley** it expands and **cools.** Therefore, Mountain breezes are generally slightly warmer than the Valley breezes.

Statement-II is correct: In mountainous regions, during the day the slopes get heated up and air moves upslope and to fill the resulting gap the air from the valley blows up the valley. This wind is known as the **valley breeze.** During the night the slopes get cooled, and the dense air descends into the valley as the **mountain breeze.**

Statement II is not correct explanation of Statement I as, Statement II only talks about direction of movement of breeze during Day and night. It does not talk about the nature of breeze i.e. whether Mountain Breeze is warmer or colder than Valley Breeze.

63. Solution: (b)

Exp) Option b is the correct answer.

Geostrophic winds are horizontal wind in the upper atmosphere that **moves parallel to isobars i.e. regions having the same pressure.** The winds in the upper atmosphere, 2 - 3 km above the surface, are free from the frictional effect of the surface and are controlled by the pressure gradient and the Coriolis force. In situations where **isobars remain straight and friction is absent, the Coriolis force counterbalances the pressure gradient force,** causing the resultant wind to flow parallel to the isobars.

Important Tips

Gradient winds are influenced by both the pressure gradient force and the Coriolis force. They blow from **high pressure towards low pressure,** but not exactly perpendicular to the pressure gradients.

Thermal winds arise due to **differences in temperature across a horizontal plane**. They blow perpendicular to the isotherms (regions having the same temperature).

Cyclonic winds blow in a circular path around a low-pressure area. Cyclonic winds rotate counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere. Coriolis force plays a major role in the formation of cyclonic winds

64. Solution: (d)

Exp) Option d is the correct answer.

In the context of atmospheric circulation, "cells" refer to **closed-loop patterns of air movement** that drive the global distribution of heat and energy. These cells consist of **rising and sinking air** masses, with distinct characteristics and locations within the atmosphere. **Hedley cells, Ferrel cells and Polar cells** play an important role in regulating the global pressure and temperature.

Ferrel Cell is a low-pressure zone which is in the mid-latitudes (30° to 60° latitude). It is characterised by **sinking air** i.e. air masses from the **Hadley cell and the Polar cell converge at the surface**. The converging air masses are forced upwards due to the Coriolis effect, leading to the formation of jet streams, hence in the Ferrel cell, **westerlies** blow from west to east.

Important Tips

Polar cells are high-pressure zones at the poles where the dense cold air from the poles sinks towards the surface, creating regions of high pressure. They encompass the regions from approximately 60° to 90° north and south latitude, playing a key role in the Earth's climate system.

The Hadley cell at the equator is the large-scale atmospheric circulation cell **responsible for the global movement of trade winds**. The belt of prevailing winds that blow from west to east in the tropics refers to the trade winds, which are part of the Hadley cell circulation pattern. The Hadley cell encompasses the region from the equator to approximately 30° north and south latitude

65. Solution: (c)

Exp) Option c is the correct answer.

Some of the below factors combined create a zone of relatively low pressure around the equator, known as the **intertropical convergence zone (ITCZ).** The ITCZ is characterized by rising air, cloud formation, and high precipitation levels, making it a key component of global weather patterns.

Option 1 is correct: As the warm air rises, it cools and condenses, forming clouds and releasing **latent heat.** This release of heat further promotes the upward movement of air, creating a strong convective current. This strong convective current furthers the rise of air from the surface and leads to low pressure in the equatorial region.

Option 2 is correct: The presence of Coriolis force in the tropical regions deflects the moving air from tropics, slightly towards its right in the Northern Hemisphere and towards its left in the Southern Hemisphere. This creates a convergence of air masses towards the equator, responsible for the development of low pressure in the equatorial region.

Option 3 is correct: The equatorial regions receive intense, direct sunlight throughout the year due to their position directly below the sun. This intense heating warms the **air, causing it to rise and expand, leading to the presence of low atmospheric pressure** at the surface.

66. Solution: (a)

Exp) Option a is the correct answer.

Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I:

In the Earth's atmosphere, **two significant forces act on air parcels: the vertical pressure gradient force (VPGF) and gravity.** The VPGF, arising from the pressure difference between air layers, pushes upwards, much stronger than the weaker horizontal pressure gradients. **However, this upward force is directly counterbalanced by gravity pulling air downwards.** Through this VPGF and gravity maintains a state called "hydrostatic equilibrium," preventing strong, sustained upward winds.

Hence the immense upward push of VPGF is precisely matched by the downward pull of gravity, keeping air parcels stable within their atmospheric layer. While VPGF has the potential for powerful vertical movement, it's effectively neutralized by gravity, ensuring our atmosphere remains relatively stable, allowing us to walk and breathe without being constantly flung upwards.

67. Solution: (d)

Exp) Option d is the correct answer.

The Inter Tropical Convergence Zone (ITCZ) is a dynamic and significant atmospheric feature that plays a crucial role in Earth's climate system. Generally, positioned near the equator, the **ITCZ represents a region where the Southeast trade winds from the Southern Hemisphere converge with the Northeast trade winds from the Northern Hemisphere.**

Statement 1 is incorrect: While the ITCZ is commonly found near the equator, **it is not strictly confined between 0-5 degrees North and South throughout the year.** The ITCZ **migrates with the Sun's apparent motion**, shifting its position seasonally. In the summer season, the sun shines vertically over the Tropic of Cancer and the **ITCZ shifts northwards**. Similarly, during winters in the Northern Hemisphere, the **sun shines vertically over the Tropic of Capricorn, resulting in ITCZ shifting southwards. For Example, In the month of July, the ITCZ is located around 20°N-25°N latitudes (over the Gangetic plain), sometimes called the monsoon trough.** This monsoon trough encourages the development of thermal low over north and northwest India. Due to the shift of ITCZ, the trade winds of the southern hemisphere cross the equator between 40° and 60°E longitudes and start blowing from southwest to northeast due to the Coriolis force. It becomes southwest monsoon. In winter, the ITCZ moves southward, and so the reversal of winds from northeast to south and southwest takes place. They are called northeast monsoons.

Statement 2 is incorrect: The ITCZ is associated with a **low-pressure zone**. As the trade winds converge at the ITCZ, **warm air ascends, creating a region of lower pressure**. Hence, the statement given is incorrect.

Statement 3 is incorrect: The low pressure created at ITCZ is known for the formation of **clouds and heavy precipitation**. The precipitation, along with thunderstorms is a frequent phenomenon in this zone. It plays a significant role in generating rainfall in the tropical regions.

68. Solution: (a)

Exp) Option a is the correct answer.

Local wind Loo is a notable meteorological phenomenon in parts of India during the summer months, characterized by its intense heat, dryness, and the challenges it poses for individuals and communities in the affected regions.

Statement 1 is correct: Loo is a striking feature of the hot weather season (summer season) in North and Northwestern India. These are strong, gusty, hot, dry winds blowing during the day over the north and northwestern India. Sometimes they even continue until late in the evening. Direct exposure to these winds may even prove to be fatal.

Statement 2 is incorrect: The formation of the Loo is **not primarily attributed to vertical movement of air** through the convection process. Instead, it is primarily caused **by horizontal movement, specifically advection**, where hot air from the Thar Desert moves horizontally towards cooler areas, leading to the loo wind.

Important Tips

Effect of the local wind 'Loo' on Biodiversity:

Due to the extremely low humidity and high temperatures, the Loo has a severe drying effect on vegetation, causing widespread browning in the areas affected in May and June. The Loo's impact on vegetation can be significant, particularly in areas already experiencing drought. Loss of vegetation can have several negative consequences, including reduced air quality, increased soil erosion, and loss of wildlife habitat.

69. Solution: (d)

Exp) Option d is the correct answer.

The Ekman spiral is named after Swedish scientist Vagn Walfrid Ekman (1874-1954) **who first theorised it in 1902.**

Statement a is correct: Ekman spiral is a consequence of both the friction force of wind and Coriolis force on ocean water. It occurs when **ocean surface waters are influenced by the friction force acting on them via the wind**. However, due to the influence of the **Coriolis effect**, the ocean water moves at a 90° angle from the direction of the surface wind.

Statement b is correct: Each layer of water molecules is moved by friction from the shallower layer, and each deeper layer moves more slowly than the layer above it, until the movement **ceases at a depth of about 100 metres** (330 feet).

Statement c is correct: When surface water molecules are moved by the wind, **they drag deeper layers of water molecules below them**. Like surface water, the deeper water is deflected by the Coriolis effect—to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. As a result, **each successively deeper layer of water moves more slowly to the right or left, creating a spiral effect.** Thus it has reduced action of wind with increasing depth of ocean water.

Statement d is incorrect: Ekman spiral(transport) leads to both increased and decreased biological activity which depend on the **upwelling (Ekman suction) and downwelling of the ocean (Ekman pumping).** Downwelling leads to nutrient poor waters, therefore reducing the biological productivity of the area and Upwelling leads to nutrient rich water thus increasing the biological productivity of the area.

70. Solution: (b)

Exp) Option b is the correct answer.

Jet streams are high-speed, narrow bands of winds in the Earth's atmosphere, in the upper troposphere and lower stratosphere, typically occurring between 7-12 kms. Jet streams can reach speeds of up to 200 miles per hour (320 kilometers per hour) and extend across thousands of kilometers. There are two primary jet streams in each hemisphere: **the polar jet stream**, which forms near the boundary between cold polar air and warmer air masses, and **the subtropical jet stream**, which is located closer to the equator.

Statement 1 is incorrect: The **typical direction of Jet streams is from west to east**. The major jet streams, including the polar jet streams and subtropical jet streams, flow from west to east, driven by the Earth's rotation and temperature differences between the equator and the poles.

Their west-to-east flow patterns are influenced by the Coriolis effect, a phenomenon caused by the rotation of the Earth, which deflects moving objects, including air masses, to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Statement 2 is correct: The **tropical easterly jet stream** is a high-altitude, fast-flowing and temporary air current located in the tropics, typically around 10 to 15 kilometers above the Earth's surface. It develops in June and continues till September-October means it is **not a permanent jet streams** and it flows from east to west (inverse to the direction of permanent jet streams), influencing weather patterns and atmospheric circulation in the tropical regions. It **steers the tropical depressions into India**. These **depressions play a significant role in the distribution of monsoon rainfall** over the Indian subcontinent. The tracks of these depressions are the areas of highest rainfall in India. The frequency at which these depressions visit India, their direction and intensity, all go a long way in determining the rainfall pattern during the southwest monsoon period.

71. Solution: (b)

Exp) Option b is the correct answer.

Local winds do not have an impact at a global level, but they **influence the weather locally.** They are formed due to **differences in temperature and pressure at the local level.** Such winds are confined to the lowest level of the troposphere.

Option 1 is incorrect: Foehn is a hot wind that blows over the Alps mountains. These are the dry and gusty winds that occur over the lower slopes. The onset of foehn is generally sudden. These winds **raise the temperatures of a region by 15 degrees to 30 degrees Fahrenheit** within an hour.

Option 2 is incorrect: Chinook are the hot winds that blow over the Eastern slopes of Rockies Mountain range in North America. Chinook is **also known as 'snow eater'** due to their ability to evaporate snow. These winds can raise temperature by 35° F within 15 minutes.

Option 3 is correct: Blizzard is a cold wind that blows over the Rocky Mountains in North America. It causes an extremely **cold and violent storm** of powdery snow ice. **Visibility gets limited** when these winds blow over a region.

Option 4 is correct: Mistral is a cold wind that blows over Rhine Valley in France. These are **dry and violent winds** that blow from north or north-west towards the Mediterranean through the Rhine valley. It can blow at any time of the year for 1-2 days, generally at a speed of 100 km/h.

Option 5 is incorrect: Zonda is a warm wind that blows over Argentina. It is a dry wind and blows over the edges **of the Andes Mountains.**

Option 6 is correct: Buran is an extremely cold wind that blows over Central Asia and Russia. It blows mostly during the winter season.

72. Solution: (b)

Exp) Option b is the correct answer.

Atmospheric circulation refers to the transfer of heat and air over the Earth's surface, driven by variations in atmospheric pressure. Air naturally moves from regions of high pressure to those of low pressure, establishing a global atmospheric circulation pattern categorized by distinct high and low-pressure belts.

Statement 1 is correct: The equatorial low-pressure belt, known as the **Doldrums**, is located around the equator and extends approximately **5 degrees north and south.** It experiences **intense heating**, causing air to expand and ascend, leading to the formation of convection currents and wind convergence. Sailors historically referred to this area as the "**Doldrums**" as sailing ships sometimes get stuck in windless waters.

Statement 2 is correct: The subtropical high-pressure belts, also known as the Horse Latitudes, are situated approximately 30 degrees north and south of the equator. Driven by the high-pressure area, winds diverge from this region and these regions are characterized by **gentle winds, clear skies, and little to no precipitation.**

It is called as horse latitude because the ships heading to the New World carrying horses stalled for days or even weeks when they encountered areas of high pressure and calm winds. These vessels, when stranded without wind to move forward, the faced shortage of resources like water and food. To conserve the resources for healthy horses, the sailors threw sick and deceased horses out of vessels into the Sea.

Statement 3 is incorrect: Temperate Low-Pressure Belts positioned approximately around latitudes **60 degrees north and south.** In these zones, the warm and cold air masses from the sub-tropical and polar high-pressure belts converge which in turn, produces **cyclonic storms. Thus, this region is not characterized by the absence of any cyclonic activity.**

Important Tips

Polar High-Pressure Belts are situated at the North and South Poles (90 degrees north and south), these belts experience consistently **low temperatures**. While the southern polar high-pressure zones are mostly over open waters, those in the northern hemisphere are influenced by the presence of land masses, making them slightly more complex.

73. Solution: (a)

Exp) Option a is the correct answer.

Anticyclones are **atmospheric circulation patterns** characterized by **high pressure at the center**, with air spiraling outwards. These weather systems typically **bring calm, clear weather conditions** with light winds and little cloud cover. The formation of anticyclones is influenced by several atmospheric conditions, including **stable atmospheric conditions, subsidence of air, and divergence of winds.**

Statement-I is correct: In an **anticyclonic condition**, also known as a **high-pressure system**, air **descends and diverges outward** at the surface. **In the Northern Hemisphere, during anticyclonic conditions, winds blow in a clockwise direction. On the other hand, in the Southern Hemisphere, winds blow in an anti-clockwise direction.**

Statement-II is correct: The Coriolis effect, which is caused by the rotation of the Earth, **deflects moving objects,** including winds, **to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.** Therefore, winds blowing from the equator towards the poles are deflected to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. Since, in an **anti-cyclonic condition, the movement of wind is in an outward direction** (due to high pressure at the center), the **Coriolis force deflects the wind to the right in Northern Hemisphere, leading to a clockwise circulation of winds.** On the other hand, in the Southern Hemisphere, Coriolis force deflects the winds to the left. Hence, the air in the outward direction starts to circulate in an anti-clockwise direction.

Hence, both the statements are correct, and statement-II correctly explains the reason for statement-I.

74. Solution: (b)

Exp) Option b is the correct answer.

Santa Ana winds blow when high pressure builds over the Great Basin — the area between the **Rocky Mountains and Sierra Nevada** — and **pressure is low over California's coast.** The difference in pressure triggers powerful winds that move from the Basin's inland deserts east and north of Southern California towards the Pacific Ocean. As the wind comes down the mountains, it compresses and heats up, and its humidity falls — sometimes to less than 10%. The hot, dry wind dries out forests, and fuels **wildfires. Santa** Ana winds are a natural part of California's climate pattern, and usually blow from **October to January.** They are well-known for their contribution to the rapid spread of wildfires in Southern California.

75. Solution: (a)

Exp) Option a is the correct answer.

General atmospheric circulation and the global wind system play a crucial role in maintaining uniform temperature and humidity over specific regions, creating favorable conditions for the formation of air masses. When the air remains over a homogenous area for a sufficiently longer time, it acquires

the characteristics of the area leading to the formation of airmass.

Statement 1 is correct: An Air mass can be defined as a large body of air whose physical properties such as temperature and humidity and lapse rate are **uniform horizontally for hundreds of kilometers.**

Statement 2 is incorrect: Air masses do not form in regions with strong atmospheric disturbances like cyclones and fronts. Instead, **they develop over stable and extensive areas.** These regions, typically large homogeneous surfaces provide uniform temperature and moisture conditions, which are essential for the formation of air masses. The major source regions of air masses include warm tropical and subtropical oceans, subtropical hot deserts, cold high-latitude oceans, snow-covered continents in high latitudes, and the permanently ice-covered regions of the Arctic and Antarctica

76. Solution: (a)

Exp) Option a is the correct answer.

The term "vortex" describes the counterclockwise movement of air that helps contain cold air near the poles. The Polar Vortex is a high-altitude jet stream that generally surrounds both the North and South Poles, consisting of strong westerly winds in the stratosphere, which enclose a vast region of extremely cold air.

Statement I is correct: Polar vortex is permanently present near the poles, but it **weakens during summer** and **strengthens in winter**.

Statement II is correct: The **temperature gradient in the polar region** (difference between polar and mid-latitude temperatures) is **greater in winter** than in **summer**. This gradient strengthens the jet stream surrounding the polar vortex during winters, keeping it stable and well-defined. **In summer, as the poles warm up due to increased solar radiation, the temperature difference decreases, causing the vortex to weaken.**

Hence option a is correct: Both Statement I and Statement II are correct, and Statement II is the correct explanation for Statement I

77. Solution: (d)

Exp) Option d is the correct answer.

Statement I is incorrect: Anabatic winds are warm, upslope winds that occur during the daytime in hilly and mountainous regions. They are caused by the heating of mountain slopes due to solar radiation. As the sun heats the slopes, the air in contact with them becomes warmer and lighter, causing it to rise. This creates an upward flow of air from the valley towards higher elevations. These winds are also called as Valley Breeze.

Katabatic winds are local winds that **flow downslope from higher elevations to lower elevations**, typically **occurring at night in hilly and mountainous regions**. These winds are caused by the cooling of air at higher altitudes, making it denser, which then leads to its downward movement due to gravity.

Statement II is correct: During the night, the earth's surface loses heat quickly due to **radiative cooling.** As a result, the air in contact with the slopes also cools rapidly. Since cold **air is denser** and heavier than warm air, it naturally **descends** (flows down) **the slopes under the force of gravity**, accumulating in low-lying valley areas. The movement of this cold air downward is what generates katabatic winds.

78. Solution: (b)

Exp) Option b is the correct answer.

A **dynamically induced** pressure belt forms due to the movement and redistribution of air masses and effect of coriolis force rather than direct heating or cooling. In contrast, a **thermally induced** pressure belt forms primarily due to differential heating of the Earth's surface.

Option 1 is correct. Subtropical High-Pressure Belts are found around **30° latitude (both hemispheres)**; these belts are also called the "Horse Latitudes." Formed due to the sinking of air from the **Hadley and Ferrel cells** as a result of dynamic atmospheric circulation. As warm air from the equator rises and moves poleward, it cools and sinks at these latitudes, creating **high pressure**. Being a result of large-scale atmospheric movement rather than direct surface heating, it is **dynamically induced**.

Option 2 is correct. Subpolar Low-Pressure Belts are found around **60° latitude (both hemispheres)**, also called the "Circumpolar Lows." Formed due to the convergence of **warm Westerlies from the subtropics** and **cold Polar Easterlies**. The difference in density and temperature between these air masses leads to frequent cyclonic activity and **low pressure.** The low pressure results from the dynamic interaction of winds rather than temperature variation, making it **dynamically induced**.

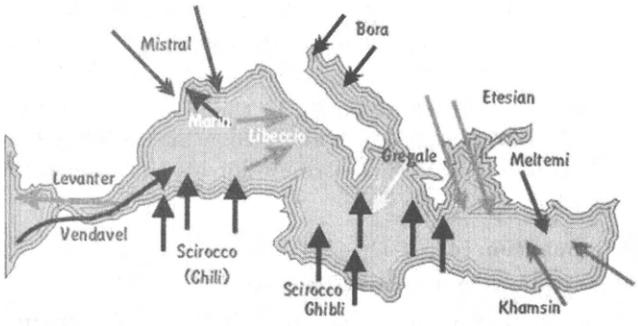
Option 3 is incorrect. The Equatorial Low-Pressure Belt is located around the **equator (0° latitude)**, also known as the "Doldrums" or **Intertropical Convergence Zone (ITCZ)**. Forms due to **intense solar heating**, causing air to rise, expand, and create a low-pressure zone.The rising air then moves toward the subtropics, creating the **Hadley Cell circulation**. Since this belt forms primarily due to **temperature-driven convection**, it is **thermally induced** rather than dynamically induced.

Option 4 is incorrect. Polar High-Pressure Belts are found around **90° latitude (both hemispheres)**, covering the Arctic and Antarctic regions. Extremely cold temperatures cause air to contract, become denser, and sink, creating **high pressure**. The high pressure is due to the **extreme cold rather than air movement**, making it **thermally induced**.

79. Solution: (b)

Exp) Option b is the correct answer.

Local winds are small-scale winds that occur due to regional temperature and pressure differences. Unlike planetary winds, which are consistent over large areas, local winds are influenced by geographical features such as mountains, seas, and deserts.



Row 1 is correctly matched: A **"Sirocco" is a hot, dry, dusty local wind that originates from the Sahara Desert** and blows across the Mediterranean Sea, making it a prominent wind type in the region surrounding the Sahara; essentially, it's a hot wind from the Sahara Desert.

Row 2 is incorrectly matched: The **bora is a cold, strong, and gusty wind that blows from the northeast European region onto the Adriatic coast.** The bora is most common in the eastern Adriatic coast, between Trieste and the Montenegrin coast. It can cause sudden temperature drops, rough seas, and is often dangerous for maritime activities. The wind is particularly strong along the **coastlines of Croatia, Slovenia, and Italy**.

Row 3 is correctly matched: The Mistral is a cold, dry, and strong wind that blows from the southern France towards the Mediterranean Sea. It's most common in the winter and spring. It leads to **clear skies but very cold conditions** in Southern France. It is particularly strong in **winter and spring**, making it difficult for agriculture but also helping in clearing fog and pollution.

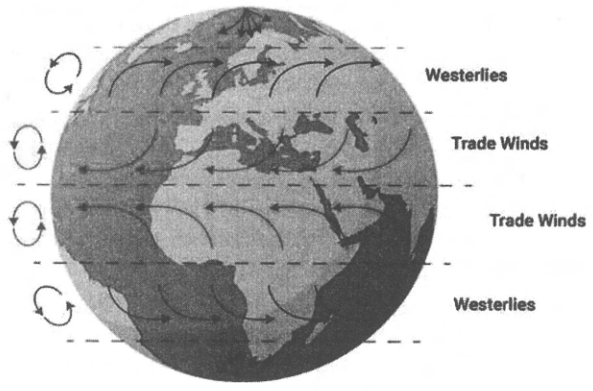
Row 4 is incorrectly matched: Gregale is a cold, northeasterly wind that blows into the Mediterranean sea. It can cause **stormy weather, high waves, and heavy rains** in the Mediterranean, particularly around the Maltese Islands. It is **not a hot wind**.

MacDonnell Range is located in Australia.

80. Solution: (a)

Exp) Option a is the correct answer.

Winds blow from high pressure regions to the low pressure regions as planetary winds.



Statement 1 is correct: Winds blowing from sub-tropical high pressure belts towards the equatorial low pressure belts become **North East Trade Winds** in the Northern Hemisphere and **South East Trade Winds** in the Southern Hemisphere. Trade winds are also called Easterlies. Since they blow from cooler sub-tropical latitudes to the warmer tropics, **they have great capacity for holding moisture. In their passage across the open oceans, they gather more moisture and bring rainfall in the eastern coast of continents that lie in the tropical regions.**

Statement 2 is correct. Winds blowing from sub-tropical high pressure belts towards the subpolar low-pressure belts are known as westerlies. They blow from the west to the east in the temperate zones. **These winds bring moisture from the oceans and cause rainfall on the western coasts of countries in the temperate regions.** For example, the west coast of North America and Europe receives rainfall due to the westerlies.

Statement 3 is incorrect. The Mediterranean region receives winter rainfall primarily due to the influence of the westerlies, not trade winds. The trade winds are mostly active in the tropical zone. During winter, the Mediterranean region comes under the influence of mid latitude cyclones associated with the westerlies.

81. Solution: (a)

Exp) Option a is the correct answer.

In recent years, an increasing number of tornadoes have formed across India and caused destruction.

Statement 1 is correct. Tornadoes are formed on land. It is a vertical column of violently rotating air that forms from a thunderstorm. It can have wind speeds in the range of 105-322 kilometres per hour. The system itself can be stationary or can move at a speed of around 97 km / hr.

Statement 2 is incorrect. The Enhanced Fujita scale is used to measure tornado strength. It is used to assign a tornado a 'rating' based on estimated wind speeds and related damage.

The MSK (Medvedev-Sponheuer-Karnik) scale is associated with earthquakes. It is used to measure the shaking effects of an earthquake on the Earth's surface, focusing on the damage caused to structures, the ground, and the natural environment.

Statement 3 is incorrect. Tornadoes are rare in India but are mostly reported in eastern states like West Bengal, Odisha, and Jharkhand during the pre-monsoon period. Though they may also occur on the western coast, the eastern coastal states are more vulnerable to the tornadoes compared to other physiographic regions in India.

82. Solution: (b)

Exp) Option b is the correct answer.

The **Coriolis force** is an apparent force **caused by the Earth's rotation**. It acts on objects in motion, such as winds and ocean currents, causing them to deflect from their straight-line paths. This force is named after the French physicist Gaspard-Gustave de Coriolis, who first described it in 1844.

Statement 1 is incorrect: The **rotation of the earth about its axis (not the revolution of earth around the sun) affects**

the direction of the wind. This force is called the Coriolis force after the French physicist who described it in 1844. It deflects the wind to the right direction in the northern hemisphere and

Statement 2 is incorrect: The pressure gradient force is the force responsible for initiating wind movement. It arises due to differences in atmospheric pressure, driving winds from areas of high pressure to areas of low pressure.

The **Coriolis force acts perpendicular** to the **pressure gradient force and the direction of wind, not parallel to it.** It deflects the wind to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

Statement 3 is correct: The **magnitude of the Coriolis force is directly proportional to the velocity of the moving object, such as wind.** As the speed of the wind increases, the Coriolis force acting on it also increases, leading to a greater degree of deflection.

83. Solution: (b)

Exp) Option b is the correct answer.

Geostrophic winds refer to **winds that blow parallel to the isobars due to a balance between the pressure gradient force and the Coriolis force.**

1. These winds are most commonly observed in the upper atmosphere, approximately 2-3 kilometers above the Earth's surface, where the effect of friction from the surface is negligible.
2. In the upper atmosphere, winds are primarily influenced by two main forces: Pressure Gradient Force (PGF) and the Coriolis Force.
3. When isobars (lines of constant pressure) are straight and there is no friction, the pressure gradient force is balanced by the Coriolis force. As a result, the wind flows parallel to the isobars. This balanced wind flow is known as geostrophic wind.

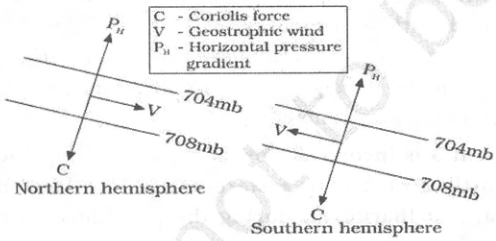
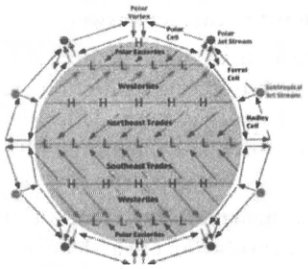


Figure 10.4 : Geostropic Wind

84. Solution: (a)

Exp) Option a is the correct answer.



Westerlies originate from the subtropical high-pressure belts (around 30 degrees latitude north and south). Air descends in these regions, creating high pressure. This descending air then flows outwards. The air moving poleward from the subtropical highs is deflected by the Coriolis effect, turning it eastward. This eastward-moving air becomes the westerlies.

85. Solution: (d)

Exp) Option d is the correct answer.

Isobars, which are lines connecting points of equal pressure, represent the horizontal distribution of atmospheric pressure across the globe. This distribution is not uniform worldwide; it varies over time at a given location and across short distances between different places.

Statement 1 is incorrect: The differences in atmospheric pressure produces a force. The rate of change of pressure with respect to distance is the pressure gradient. **The vertical pressure gradient force is much larger than that of the horizontal pressure gradient.** But, it is generally balanced by a nearly equal but opposite gravitational force. Hence, we do not experience strong upward winds.

Statement 2 is incorrect: When isobars are closely spaced on a weather map, it signifies a steep pressure gradient, meaning a rapid change in pressure over a short distance, which often leads to strong winds. Conversely, widely spaced isobars indicate a gentle pressure gradient with lighter winds. **Hence, Close spacing of isobars expresses steep pressure gradient while wide spacing indicates gentle pressure gradient.**

86. Solution: (a)

Exp) Option a is the correct answer.

The pattern of wind circulation is modified in different seasons due to the shifting of regions of maximum heating, pressure and wind belts. The **pressure gradient** refers to the rate of change in atmospheric pressure over a specific distance. It is **the driving force that causes air to move from high-pressure areas to low-pressure areas.**

In mountainous regions, the movement of air between slopes and valleys changes with the time of day due to temperature variations. During the day, the slopes of mountains heat up faster than the surrounding valleys. This heating causes the air near the slopes to become warm and less dense, creating a low-pressure zone. To fill the gap left by the rising warm air, cooler air from the valley flows upward toward the slopes. This phenomenon is known as a valley breeze.

At night, the slopes cool rapidly due to radiational cooling, while the valley retains some warmth. The cooler, denser air on the slopes creates a **high-pressure zone**, and this air begins to flow downhill into the valley, where the air pressure is lower. This downslope flow of cool air is referred to as a **mountain breeze or Katabatic wind.**

Thus, the pressure gradient between the slope of the mountain and the valley act as the main driving force of the flow of Katabatic wind.

87. Solution: (c)

Exp) Option c is the correct answer.

The pressure gradient between the valley and mountain slopes drives the movement of air, creating valley and mountain winds as local winds.

Statement I is correct: A valley breeze occurs during the daytime when air rises from the valley towards the mountain slopes. **In contrast, a mountain breeze occurs at night** when cooler, denser air flows downslope from the mountain to the valley.

Statement II is incorrect: In mountainous regions, **during the day, the mountain slopes heat up faster than the valley**, causing the air to rise upslope. Similarly **at night, the mountain slopes cool down faster than the valley,** and the denser, cooler air descends into the valley, forming the mountain breeze/wind.

Thus, Valley and mountain breezes are caused by the pressure gradient created as the mountain slopes heat up and cool faster than the valley. **Hence option c is correct:** Statement I is correct, but Statement II is incorrect.

88. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: The **Hadley cell** is a tropical atmospheric circulation characterized by air **rising at the equator (due to heating)**, moving poleward, and then **descending roughly** around 30 degrees latitudes (**at subtropical high-pressure belts**).

Statement 2 is correct: In Hadley cell surface winds (trade winds) blow towards the equator. **The Ferrel cell has surface winds (westerlies) blowing away from the equator (towards the poles).** This opposing wind direction is a key distinction between the two cells.

89. Solution: (a)

Exp) Option a is the correct answer.

The Westerlies are prevailing winds from the west toward the east in the middle latitudes between 30°N and 60°N, and 30°S and 60° S. They originate from the high-pressure areas in the horse latitudes and tend towards the poles and steer extra tropical cyclones in this general manner. Westerlies in southern hemisphere are stronger and persistent than in northern hemisphere.

Statement 1 is correct. Land comprises only 19.1% of Southern Hemisphere, In Northern Hemisphere, the majority of area is composed of land masses. Less landmass in Southern Hemisphere results in lesser frictional drag in motion of westerlies, thus resulting in stronger and persistent Westerlies.

Statement 2 is incorrect. Coriolis force is equal in both the hemispheres at their respective latitudes. The magnitude of the Coriolis force depends on the speed of the object and its latitude. The Coriolis force is zero at the equator and increases toward the poles.

90. Solution: (c)

Exp) Option c is the correct answer..

The Inter Tropical Convergence Zone (ITCZ) is a low-pressure zone located at the equator where trade winds from two hemispheres converge. It is a zone where air tends to ascend.

This convergence zone lies more or less parallel to the equator but moves north or south with the apparent movement of the sun.

Option c is correct. The Intertropical Convergence Zone is formed when the **trade winds** of the Northern and Southern Hemispheres come together. In the **northern hemisphere** the northeast trade winds converge with southeast winds from the **Southern Hemisphere**. The point at which the trade winds converge forces the air up into the atmosphere, forming the ITCZ.

91. Solution: (b)

Exp) Option b is the correct answer.

An air mass is a large volume of air in the atmosphere that is mostly uniform in temperature and moisture. A source region of air masses must have **fairly homogeneous surface** conditions of **temperature and moisture** content i.e., possessing **homogeneous isolation** throughout to impart homogeneity to the air mass.

Statement a is incorrect Air masses have **fairly uniform temperature and moisture** content in horizontal direction. Air masses form over large surfaces with uniform temperatures and humidity, called source regions. There are four categories for air masses: arctic, tropical, polar and equatorial.

Statement b is correct. Air masses can extend thousands of kilometers in any direction, and can reach from ground level to the stratosphere up to 16 kilometers into the atmosphere.

Statement c is incorrect. Air masses are formed in the polar region. There are four categories for air masses: arctic, tropical, polar and equatorial. Arctic air masses form in the Arctic region and are very cold. Polar air masses take shape in high-latitude regions and are cold.

Statement d is incorrect. Air masses move from one region to another under the influence of **pressure gradients** and **upper-level wind patterns**. They are sometimes pushed or blocked by **high level jet streams**. Air masses form an integral part of the **global planetary wind system**. Therefore, they are associated with one or other wind belt.

92. Solution: (b)

Exp) Option b is the correct answer.

The air in motion is called wind. Wind is moving air and is caused by differences in air pressure within our atmosphere. Air under high pressure moves toward areas of low pressure. The greater the difference in pressure, the faster the air flows.

Statement 1 is incorrect. The horizontal winds near the earth surface is the result of the **combined effect of three forces** – the **pressure gradient force, the frictional force and the Coriolis force**. In addition, the gravitational force also acts downward. The wind at the surface experiences **friction** which is responsible for **limiting the speed** of the wind. Along with that **gravitational force** is also responsible for wind direction, which acts downwards.

Rotation of the earth also affects the wind movement. The force exerted by the rotation of the earth is known as the Coriolis force. In the Northern Hemisphere, wind and currents are deflected toward the right, in the Southern Hemisphere they are deflected to the left.

Statement 2 is correct. The friction force on the wind is **more at the land surface than on the sea surface**. Frictional Force is **greatest at the surface** and its influence generally extends up to an elevation of 1 – 3 km. **Over the sea surface the friction is minimal.** Over uneven terrain, however, due to high friction, the wind direction makes high angles with, isobars and the speed gets retarded.

Important Tips

Pressure Gradient Force

The differences in atmospheric pressure produce a force. The rate of change of pressure with respect to distance is the pressure gradient. The pressure gradient is strong where the isobars are close to each other and are weak where the isobars are apart.

Frictional Force

It affects the speed of the wind. It is greatest on the surface and its influence generally extends up to an elevation of 1 – 3 km. Over the sea surface, the friction is minimal.

Coriolis Force

The Coriolis force acts perpendicular to the pressure gradient force. The pressure gradient force is perpendicular to an isobar. The higher the pressure gradient force, the more is the velocity of the wind and the larger is the deflection in the direction of wind.

93. Solution: (d)

Exp) Option d is the correct answer.

Coriolis force is an apparent force caused by the earth's rotation. The magnitude of the Coriolis force depends on the speed of the object and its latitude.

Statement a is correct. The Coriolis force is responsible for deflecting winds towards the right in the northern hemisphere and towards the left in the southern hemisphere. This is also known as 'Ferrel's Law'.

Statement b is correct. Coriolis force is absent at the equator and highest at the poles. The Coriolis force acts perpendicular to the pressure gradient force. The pressure gradient force is perpendicular to an isobar. At the equator the wind blows perpendicular to the isobars. Thus, the Coriolis force is zero at equator and it increases moving towards poles.

Statement c is correct. Where a cyclone forms, the direction it spins and the general path it takes are determined by a range of factors including the Coriolis force. Cyclones are formed due to the presence of a low-pressure zone. As the low pressure intensifies over a period of time (depending on various factors) the surrounding air rushes in to fill it. As the air is rushing in it will rotate according to the Ferrel's law and will cause cyclones to rotate anticlockwise in the northern hemisphere and clockwise in the southern hemisphere.

Statement d is incorrect. The Coriolis effect bends the direction of surface currents to the right in the Northern Hemisphere and left in the Southern Hemisphere. This is true for the deep-water circulation as well.

4.4. Humidity and Precipitation

94. Solution: (b)

Exp) Option b is the correct answer.

The amount of Water Vapour present in the air is known as humidity. It is expressed quantitatively in different ways.

Pair 1 is incorrect: Specific Humidity (not relative humidity) is the ratio of the mass of water vapour to the total mass of the air parcel.

Whereas Relative humidity is the ratio of the amount of water vapor actually in a volume occupied by air to the amount the space could contain at saturation. The **percentage of moisture present in the atmosphere as compared to its full capacity at a given temperature** is known as the relative humidity. The relative humidity of an air at saturation point is hundred percent.

Pair 2 is correct: Dew point is **the temperature at which the air becomes fully saturated** (100 percent relative humidity). It is dependent on only the amount of moisture in the air.

Pair 3 is correct: Absolute humidity is the actual amount of water vapour present in the air. In other words, **it is the mass of water vapor divided by the mass of dry air in a volume of air.** It does not take temperature into consideration. Absolute humidity in the atmosphere ranges from near zero to roughly 30 grams per cubic meter when the air is saturated at 30 °C. The absolute humidity differs from place to place on the surface of the earth.

95. Solution: (c)

Exp) Option c is the correct answer.

Noctilucent clouds are the highest clouds in the Earth's atmosphere, 83 km (50 miles) and are observed slightly below the mesopause in the polar summertime. These clouds are of special interest, as they are sensitive to both global climate change and to solar/terrestrial influences. The first recorded sightings of noctilucent clouds were reported in 1885 and both satellite and ground-based observations over the past four decades have indicated that the presence of these clouds has been increasing in both frequency and brightness. Scientists now realize that these clouds are very sensitive indicators for what is going on in the atmosphere at higher altitudes as small changes in the atmospheric environment can lead to large changes in the properties of these clouds. Further, since these clouds form on condensation nuclei through cold temperatures and the presence of water vapor – and these properties of the mesosphere are tied to carbon dioxide and methane, the anthropogenic causes of climatic change may be directly related to the presence of noctilucent clouds.

96. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct. A **storm surge** is a rise in sea level that occurs during tropical cyclones, intense storms also known as typhoons or hurricanes. The storm surge is a result of atmospheric pressure and Coriolis force that produces strong winds pushing the water into shore, which can lead to flooding. This makes storm surges very dangerous for coastal regions. **Typhoon Haiyan in 2013** is one of the current examples of a devastating storm surge.

Option b is incorrect. Tsunamis are giant waves that are produced when a large volume of water is displaced in an ocean or large lake by movements in Earth's outer layer, or crust like an earthquake, volcanic eruption, underwater landslide or meteorite.

Option c is incorrect. Flooding is the process where the water overflows or soaks land that is normally dry caused by large storm or tsunami that leads the water of the sea or river to rush inland.

97. Solution: (b)

Exp) Option b is the correct answer.

There is a continuous process of condensation occurring in the free air. When the resistance of the air fails to hold them against the force of gravity, they fall on to the earth's surface. So, after the condensation of water vapour, the release of moisture is known as precipitation. This may take place in liquid or solid form.

Option a is incorrect: Precipitation taking place when the **temperature is lower than the 0°C** in the form of fine flakes of snow is called **snowfall**. Moisture is released in the form of hexagonal crystals. These crystals form flakes of snow.

Option b is correct: Sleet is frozen raindrops and refrozen melted snow-water. When a layer of air having above freezing point temperature overlies a subfreezing layer near the ground, precipitation takes place in the form of sleet. Raindrops leaving the warmer air, encounter the colder air below. As a result, they solidify and reach the ground as small pellets of ice not bigger than the raindrops from which they are formed.

Option c is incorrect: Hailstones have several concentric layers of ice one over the other. Drops of rain after being released by the clouds become solidified into small rounded solid pieces of ice and which reach the surface of the earth are called hailstones. They are associated with thunderstorms and individual hail stones are 5 mm or greater in diameter.

Option d is incorrect: Ice-crystals are falling crystals of ice in the form of needles, columns, or plates. They occur in very cold region. Also called 'diamond dust', ice crystals appear like fog with individual water particles forming directly as ice.

98. Solution: (b)

Exp) Option b is the correct answer.

Cloud is a mass of small water droplets or tiny crystals of ice formed by the condensation of the water vapour in free air at considerable height. They take various shapes according to their elevation. According to their height, expanse, density and transparency or opaqueness clouds are grouped under four types:

(i) cirrus

(ii) cumulus

(iii) stratus

(iv) nimbus

Pair 1 is incorrect: Cumulus clouds look like cotton wool having flat base. They are generally formed at a height of 4,000 - 7,000 m. They are usually spotted in fair weather. They exist in patches and can be seen scattered here and there. **Cirrus clouds are white, thin, and detached clouds having a feathery appearance**. They are high clouds, formed at altitudes of 8,000 - 12,000m.

Pair 2 is correct: Stratus clouds low level clouds characterised by layering and covering large portions of the sky. These clouds are generally formed either **due to loss of heat or the mixing of air masses with different temperatures.**

Pair 3 is correct: Nimbus clouds are featureless mass of thick vapour. They are extremely dense and opaque to the rays of the sun. Sometimes, the clouds are so low that they seem to touch the ground. They are in colour of black or dark grey. They form at middle levels or very near to the surface.

99. Solution: (d)

Exp) Option d is the correct answer.

Humidity is the amount of water vapour in the air. Atmospheric water vapour regulates air temperature by absorbing thermal radiation both from the Sun and the Earth. Water vapour is the ultimate source of all forms of condensation and precipitation.

Option a is incorrect: Relative Humidity is the percentage ratio of actual water vapour contained in the given sample of air to the maximum quantity of vapour that air sample can hold at that temperature. If the temperature of sample of air is raised, its capacity to hold water vapour increases and if so, its relative humidity will decrease. It is often expressed in percentage.

Option b is incorrect: The dew point is the temperature the air needs to be cooled to (at constant pressure) in order to achieve a relative humidity of 100%. At this point the air cannot hold more water in the gas form. **Dew point temperature is commonly referred to as the dew point** is another way of expressing humidity. It is a temperature to which a sample of air should be lowered in order to saturate it with respect to its water vapour content.

Option c is incorrect: Specific Humidity is defined as the ratio of mass of water vapour to the mass of moist air. Absolute and specific humidity are quite similar in concept. The specific humidity does not vary as the temperature or pressure of a body of air changes, as long as moisture is not added to or taken away from it.

Option d is correct: Absolute Humidity is the measure of water vapor in the air, regardless of the temperature. **It is expressed as grams of moisture per cubic meter of air (g/m3). The higher the amount of water vapor, the higher is the absolute humidity.**

100. Solution: (a)

Exp) Option a is the correct answer.

Rainfall is the **lifeblood of our planet, nurturing ecosystems, sustaining agriculture, and shaping the very landscapes** we inhabit. However, this precious resource is **not distributed evenly across the globe,** as various locations on the Earth experience **varying annual rainfall,** distributed across **different seasons.**

Statement 1 is incorrect- In **warm temperate latitudes (35° to 40° N and S),** the **eastern margins of continental coast receive more rainfall than the western margins.** The reason for heavier rainfall is often associated with prevailing wind patterns and orographic effects. In many regions, the prevailing winds, known as the **trade winds, blow from east to west.** As moist air from the ocean moves towards the land, it is forced to **ascend over elevated coastal areas.** As the air rises, it **cools, and cooler air has a reduced capacity to hold moisture.** Consequently, this leads to the condensation of water vapor, cloud formation, and ultimately, **heavier rainfall on the windward (eastern) side of these coastal regions.** On the leeward (western) side, the descending air tends to be drier, resulting in decreased rainfall.

Statement 2 is incorrect- Heavy rainfall exceeding 200 cm per year is observed in the **equatorial belt,** the **windward slopes of mountains along the western coasts** in the **cool temperate zone,** and the **coastal regions of monsoon-influenced lands. Continental interiors** of the tropical zone receives **very less rainfall of nearly 50 cm per year.**

Statement 3 is correct- The **British type of climate,** characterized by the **influence of the Westerlies** on **cool temperate western margins year-round,** is often associated with regions experiencing **frequent cyclonic activity.** Commonly referred to as the **Cool Temperate Western Margin Climate or North-West European Maritime Climate,** these areas **encounter rainfall consistently throughout the year. Winters tend to be cool and rainy,** while **summers are warm and also marked by rainfall.** The weather in these regions is highly unpredictable, reflecting the variability typical of this climate type.

101. Solution: (a)

Exp) Option a is the correct answer.

Convectional rainfall is a type of precipitation that occurs when **warm, moist air rises rapidly and cools adiabatically,** causing water vapor to **condense into liquid water droplets.** This phenomenon typically occurs in areas with **strong solar heating,** such as **over land surfaces during the day or in tropical regions.**

Stages in Convectional Rainfall:

1. **Solar heating:** The sun warms the Earth's surface, causing water to evaporate from bodies of water, soil, and vegetation. This water vapor rises into the atmosphere.
2. **Adiabatic cooling**: As the air rises, it expands and cools at a rate of approximately 10°C per kilometer (5.5°F per 1,000 feet). This cooling occurs without the exchange of heat with the surrounding environment.
3. **Condensation:** As the air cools, it reaches a point where it can no longer hold as much water vapor. At this point, the water vapor condenses into tiny water droplets, forming clouds.
4. **Precipitation:** If the conditions are favorable, such as sufficient moisture and instability in the atmosphere, the water droplets will grow larger and collide, eventually becoming heavy enough to fall as rain.

Statement 1 is correct- In equatorial regions, high insolation and abundant moisture synergistically drive convective rainfall, particularly around midday. **The insolation from sun directly warms the ground, elevating air temperature and increasing its capacity to hold more water vapor. This humid air ascends, cools adiabatically, and condenses into towering cumulus clouds. This leads to precipitation peaking at noon.** This convection cycle is the primary mechanism for afternoon rain near the equator.

Statement 2 is incorrect- Rainfall in India is **predominantly Orographic in nature.** Orographic rainfall is initiated when **humid air ascends near a mountain range,** passing over it. As the air moves , it undergoes **cooling, leading to the formation of orographic clouds,** the primary contributors to precipitation. On the leeward side of the mountain range, this type of rainfall descends with the wind. A portion of the precipitation occurs shortly beyond the ridge, referred to as spillover. The **Southwest monsoon,** which accounts for about **75% of the total annual rainfall in India, is primarily orographic in nature.** On the other hand, **convectional rainfall mainly occurs in equatorial regions of the world.**

102. Solution: (a)

Exp) Option a is the correct answer.

Statement I is correct- Humidity is the **amount of water vapor in the air.** The **humidity levels during the summer season tend to be higher when compared to those experienced in winter.** In the summer, humidity levels can be between **50 and 60 per cent.**

Statement II is the correct explanation for Statement I- Warm air can hold more moisture than cold air. The **warmer the air, the more water vapor it can hold.** As temperatures rise in the summer, the **air becomes saturated with more water vapor,** leading to **higher humidity levels** in the summer.

103. Solution: (d)

Exp) Option d is the correct answer.

Relative humidity is a measure of the **amount of water vapor present** in the air **relative to the maximum amount of water vapor the air can hold at a given temperature.**

Relative Humidity= Actual water vapor density/ Saturation vapor density*100

Relative humidity is **influenced by both the actual water vapor content in the air and the air's temperature.** When the relative humidity is high, it indicates that the air is holding a significant amount of water vapor relative to its total water holding capacity at that temperature. **When**

relative humidity reaches 100%, the air is completely saturated. The air temperature is said to be at dewpoint.

Statement-I is incorrect: If the relative humidity is 100 percent (i.e., dewpoint temperature and actual air temperature are the same), this does NOT necessarily mean that precipitation will occur. It simply means that the maximum amount of moisture is in the air at the particular temperature the air is at. Saturation may result in fog (at the surface) and clouds aloft (which consist of tiny water droplets suspended in the air). However, for precipitation to occur, the air must be rising at a sufficient rate to enhance condensation of water vapor into liquid water droplets or ice crystals (depending on air temperature) and to promote growth of water droplets, supercooled droplets, and/or ice crystals in clouds. Once the suspended precipitation particles grow to sufficient size, the air can no longer support their weight and precipitation falls from the clouds.

Statement-II is correct: As temperature decreases, the air's capacity to hold water vapor also decreases. Therefore, if the amount of water vapor in the air remains constant, **the relative humidity increases** because the air's capacity to hold moisture has decreased. Cold air can hold lesser moisture, leading to a higher relative humidity.

104. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect: Fog and mist are both created by water droplets. When the temperature of an air mass containing a large quantity of water vapor falls suddenly, condensation takes place on fine dust particles, leading to the formation of fog and mist. The only difference between mist and fog is that mist contains more moisture than fog.

Statement 2 is correct: Fog is **much denser than mist** and has a greater effect on visibility. Fog reduces visibility to less than 1 km (0.6 miles), while mist reduces visibility to between 1 and 2 km (0.6 - 1.2 miles). Fog can obscure objects and create halos around lights, while mist can create a soft and hazy effect.

Fog is **slower to dissipate and can persist for hours or days**, while mist is quicker to disappear with even slight winds. Fog is more stable and resistant to changes in temperature and pressure, while mist is more volatile and sensitive to environmental factors.

105. Solution: (d)

Exp) Option d is the correct answer.

Tiny droplets of water vapor which are **too small to fall as rain or snow and remain suspended in the air** are called clouds. Clouds can be classified into various types based on their form, height, and appearance.

1) The **'cirrus'** clouds are known as the **'high' clouds** (20,000-40,000 feet above ground).
2) The **'alto'** clouds are the **middle-height clouds** (7,000-20,000 feet above ground)
3) The **'stratus'** clouds are the **low-height clouds** (mainly below 7,000 feet above ground)
4) The **clouds with great vertical extent**, which are **mainly cumulus clouds** with no definite height.

Cumulonimbus clouds are known for their towering vertical extent (2,000-30,000 feet), reaching high into the atmosphere, often up to the tropopause or beyond. They have a distinctive appearance **resembling a cauliflower**, with a dense, dark base and a towering, **anvil-shaped top.** These clouds are associated with **intense convective activity, producing heavy precipitation, thunderstorms, lightning,** and sometimes severe weather phenomena such as hail, strong winds, and tornadoes. Therefore, cumulonimbus clouds are **commonly referred to as thunder-clouds** due to their association with thunderstorms. **These clouds are also formed during tropical cyclones.** The tropical cyclone initiates from a collection of cumulonimbus clouds.

106. Solution: (c)

Exp) Option c is the correct answer.

Noctilucent clouds are **very thin and composed of ice crystals.** These are the **highest clouds in the atmosphere, located in the mesosphere at an altitude of approximately 85 km.** They are only visible when illuminated by light from below i.e. after the sun has gone below the horizon. They are most commonly observed in the **summer months at latitudes between 50° and 70° north and south of the equator.**

Statement 1 is correct: Noctilucent Clouds are **located in the mesosphere,** which is the third layer of the Earth's atmosphere, situated above the stratosphere and below the thermosphere. **The mesosphere is a very cold and dry region, making it conducive to the formation of ice crystals,** which are the primary components of NLCs.

Statement 2 is correct: While the mesosphere is **extremely cold year-round, it is coldest during the summer at high latitudes.** This is due to the unusual way that air circulates in the mesosphere. The very cold summer mesosphere, combined with the presence of water vapor and dust particles, allows ice crystals to form and **become visible as Noctilucent Clouds.** The clouds are also only visible during summer, because of the angle of the sun, and the fact that the sun illuminates them from below the horizon, while the observer is in darkness.

107. Solution: (a)

Exp) Option a is the correct answer.

If a parcel of air contains moisture to its full capacity at any given temperature, then it is said to be saturated. It means that the air at that given temperature is incapable of holding any additional amount of moisture at that stage

Option a is correct. The temperature at which saturation occurs in a given sample of air is known as dew point. Thus, at dew point, the air parcel is not capable of holding any additional amount of moisture at that stage.

The amount of water vapour present in the air is known as humidity. It is expressed quantitatively in different ways.

The **actual amount of the water vapour present in an air sample is** known as the absolute humidity.

The **percentage of moisture present in an air sample as compared to its full capacity** at a given temperature is known as the relative humidity. When the relative humidity is 100%, it means that the **air sample contains 100% of water vapor of its full capacity.** Such an air parcel is not capable of holding any more moisture and has thus attained saturation. We can thus say that the air parcel has attained the dew point temperature.

Thus, when the relative humidity reaches 100% at a given temperature, the air becomes completely saturated. This air temperature is said to be at dew point.

So, the temperature of a parcel of air is said to be at dew point if the **relative humidity of the air parcel is 100%.**

Option b is incorrect. The Critical Temperature is the temperature at and above which vapor of a substance cannot be liquefied, no matter how much pressure is applied.

Option c is incorrect. The temperature of a parcel of air cannot said to be at dew point if relative humidity is 0%. As relative humidity 0% indicates the air is not saturated and it can hold more moisture.

Option d is incorrect. A freezing point is defined as the temperature at which a substance transitions from a liquid to a solid state under atmospheric pressure.

108. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is incorrect: The **actual amount of water vapour present** in the **air at a given temperature is** known as **absolute humidity, not relative humidity**.

- **Relative humidity**, on the other hand, is the **ratio of absolute humidity to saturation humidity (the maximum amount of water vapour air can hold at a specific temperature),** expressed as a percentage.
- Therefore, relative humidity measures how close the air is to being saturated with moisture, rather than just the amount of moisture present.

Statement 2 is incorrect: Generally, **relative humidity decreases with an increase in temperature if the amount of moisture in the air stays constant**.

- This is because warmer air can hold more moisture, and thus the Relative Humidity tends to decrease with an increase in temperature.
- However, in some cases (like over oceans or in humid environments), if the air is also receiving more moisture with the temperature rise, RH can increase.
- So, generally, relative humidity decreases with temperature increase unless there is a simultaneous increase in moisture content.

Statement 3 is correct: **Relative Humidity** tends to be **higher over oceans than over land** because oceans provide a continuous source of moisture through evaporation. Water bodies have higher moisture availability, leading to higher Relative Humidity. In contrast, land areas have lower moisture content in the air due to limited supply of moisture, leading to lower relative humidity.

109. Solution: (b)

Exp) Option b is the correct answer.

Dew is the moisture that condenses in the form of water droplets on cooler surfaces of solid objects, rather than nuclei in the air above. This happens when the air near the surface cools down to the **dew point**, the temperature at which air becomes saturated and can no longer hold all the water vapor it contains.

The ideal conditions for its formation include **clear skies, calm air, high relative humidity,** and **cold, long nights**. For dew to form, the **dew point must be above the freezing point**

Option 1 is correct: Clear sky – Favorable:

When the sky is clear, there are no clouds to trap the heat that the ground radiates during the night. This allows for the ground to cool more effectively, leading to the cooling of the air just above the ground. This cooling is essential for dew formation.

Option 2 is correct: Calm air – Favorable:

Calm conditions prevent the mixing of air layers. In windy conditions, warmer air can be mixed with the cooler air near the ground, which disrupts the cooling process necessary for dew formation. Calm air ensures that the cool layer of air remains undisturbed, allowing dew to form.

Option 3 is correct: Cold and long nights – Favorable:

Cold and long nights give enough time for the surface to cool down. The longer the night, the more time the Earth's surface has to radiate heat and reach a temperature where it can cause condensation of air moisture (dew formation.).

Option 4 is incorrect: Low relative humidity – Not favorable:

Low relative humidity means the air has less amount of moisture to condense into dew. Dew forms when the air reaches its saturation point, i.e., when it cools to the dew point temperature. If the relative humidity is low, the air is less likely to reach saturation, and dew is less likely to form.

Option 5 is incorrect: Dew point is lower than the freezing point – Not favorable:

If the dew point is lower than the freezing point, the moisture in the air will directly freeze into frost or ice crystals rather than condensing into liquid dew.

110. Solution: (b)

Exp) Option b is the correct answer.

Clouds are visible accumulations of tiny water droplets or ice crystals in Earth's atmosphere. Clouds are classified into: cirrus, stratus, nimbus and cumulus.

Option a is incorrect. Stratocumulus clouds are often **associated with rain or other types of precipitation.** They are fluffy and **relatively low to the ground.**

Option b is correct. Cirrus clouds are clouds that form high in the troposphere. Cirrus clouds let pass most of the incoming solar radiation but trap the heat from getting out of the Earth system. Therefore, they have a net warming

effect on Earth. A warming Earth will likely produce more cirrus clouds, potentially resulting in a self-reinforcing loop.

Cirrus clouds are wispy, curly, or stringy. Cirrus clouds are formed at high altitudes (8,000 - 12,000m) and are usually made of ice crystals. Cirrus clouds **usually signal clear, fair weather.**

Option c is incorrect. Cumulus clouds are large and lumpy. They are generally formed at a height of 4,000 - 7,000 m.

Cumulus clouds are created by strong updrafts of warm, moist air. **Most forms of heavy precipitation fall from cumulus clouds.**

Option d is incorrect. Stratus clouds are thick, low grey clouds that block sunlight from reaching the Earth like an umbrella and thus **have a net cooling effect on Earth.** Stratus clouds are horizontal and stratified, or layered. Stratus clouds can blanket the entire sky in a single pattern. **They usually occur close to Earth**. The presence of stratus clouds usually **means a chilly, overcast day.**

111. Solution: (d)

Exp) Option d is the correct answer.

The precipitation in the form of water is called rainfall. Different places on the Earth receive different amounts of rainfall in a year. There are also seasonal variations in the distribution of rainfall.

Statement 1 is correct. It is true that between the latitudes 35 and 40 degrees N and S of the equator, the rain is heavier on the eastern coasts and goes on decreasing towards the west.

Statement 2 is correct. It is true that the **coastal areas of the world receive greater amounts of rainfall than the interior of the continents**.

In general, as we proceed from the equator towards the poles, rainfall goes on decreasing steadily.

Statement 3 is correct. It is correct that **between 45 and 65 degrees N and S of the equator**, due to the westerlies, **the rainfall is first received on the western margins of the continents and it goes on decreasing towards the east.**

112. Solution: (d)

Exp) Option d is the correct answer.

The ocean is a significant influence on Earth's weather and climate. The ocean covers 70% of the global surface. This great reservoir continuously exchanges heat, moisture, and carbon with the atmosphere, driving our weather patterns and influencing the slow, subtle changes in our climate.

Statement 1 is correct. The oceans influence climate by **absorbing solar radiation and releasing heat needed to drive the atmospheric circulation**. It releases aerosols that influence cloud cover, by emitting most of the water that falls on land as rain, by absorbing carbon dioxide from the atmosphere and storing it for years to millions of years.

Statement 2 is correct. The tropics are particularly rainy because heat absorption, and thus ocean evaporation, is highest in this area. Hence, it helps to **distribute heat around the globe**

When water molecules are heated, they exchange freely with the air in a process called evaporation. Ocean water is **constantly evaporating, increasing the temperature and humidity** of the surrounding air to form rain and storms that are then carried by trade winds. In fact, almost all rain that falls on land starts off in the ocean.

Statement 3 is correct. Carbon dioxide is also transferred through the air-sea interface. Deep water of the ocean can store carbon dioxide for centuries. Carbon dioxide dissolves in cold water at high latitudes, and is subducted with the water. It stays in the deeper ocean for years to centuries before the water is mixed back to the surface and warmed by the sun. The warm water releases carbon dioxide back to the atmosphere.

113. Solution: (b)

Exp) Option b is the correct answer.

The process of changing/turning vapour [**Gases**] directly into the ice [**Solid**] is called **desublimation or Deposition.**

Option b is correct. Deposition is the **phase transition process** in which gas (vapour) transforms into solid without passing through the liquid phase transition. Deposition is a **thermodynamic process**. The reverse of deposition is sublimation in which the solid directly transforms into gas(vapour) without passing through the liquid phase and hence sometimes deposition is called desublimation.

Sublimation is most often used to describe the process of snow and ice changing into water vapor in the air without first melting into water.

114. Solution: (d)

Exp) Option d is the correct answer.

Sleet are small ice particles that form from the freezing of liquid water drops, such as raindrops. Hail is frozen precipitation that can grow to very large sizes through the collection of water that freezes onto the hailstone's surface.

Statement 1 is correct. Sleet is formed under the conditions of temperature inversion. When the falling snow reaches the layer of warm air, it melts, then it hits the layer of cold air just above Earth's surface and refreezes. This results into creation of tiny ice pellets called as **sleet.**

Statement 2 is correct. Sleet forms in winter storms, while **hail is a warm-season type** of precipitation. Sleet forms when snow melts in a warm layer and then refreezes into ice pellets as it falls though a cold layer. Hail, however, forms in spring, summer or fall thunderstorms.

Statement 3 is correct. Sleet pellets are normally smaller than hail. Due to repeated upliftment of frozen pellets by the upward air current of the air, the **hailstones are made of many layers of ice which increases their size**. Hence, hailstones are larger pellets than the pellets that make up sleet.

Hailstones are clumps of layered ice that form in updraughts (rising air) within thunderstorms. Hailstones form when an **upward current of air generated by thunderstorms lift water droplets high in the troposphere**. When the raindrops

freeze in the upper atmosphere and fall down then they **are again lifted by the upward air currents** of the thunderstorm. This continues till the pellets become too heavy to be lifted by the air currents and fall to the ground as hailstone

4.5. Climatic Processes: Cyclone, El-Nino etc.

115. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: An anticyclone, commonly known as a high, is an area **of high pressure where air moves apart from the centre of the anticyclone and sinks.** Anticyclones are regions of relatively high pressure on horizontal surfaces, or high geo potential height on isobaric surfaces, around which air circulates clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere.

Statement 2 is incorrect: Anticyclones are often regions of clear skies. It typically indicates fair weather. Winds in an anticyclone blow clockwise in the Northern Hemisphere and counterclockwise in the Southern Hemisphere.

Statement 3 is correct: Air at the centre of an anticyclone is forced away from its area of high pressure and replaced by a downward blast of air from higher altitudes. The **air compresses and heats up** as it moves downward, **reducing its humidity and leading to fewer clouds within the anticyclone.** Although not as actively researched as cyclones, anticyclones are important because the clear, dry conditions usually associated with them may allow strong night-time radiates cooling and cold surface temperatures. The convectively stable air of anticyclones may allow air pollutants to concentrate near the Earth's surface.

116. Solution: (d)

Exp) Option d is the correct answer.

A cold wave is a rapid fall in temperature within a 24-hour period. A cold wave is a weather phenomenon that is distinguished by the cooling of the air. Cold wave conditions develop if the temperature falls rapidly much below normal.

Statement 1 is correct: Foggy weather developed during the day which inhibits day warming and provides favorable conditions for cold wave conditions to linger on.

Statements 2 and 3 are correct: Clear sky conditions during the night, further facilitate lowering of temperature by radiation cooling. Occasionally, in the absence of western disturbances and persistent clear sky conditions, intense nocturnal radiation cooling may also cause night temperatures to fall below normal and result in cold wave conditions.

117. Solution: (c)

Exp) option c is the correct answer.

Statement 1 is correct. The Walker Circulation is an atmospheric system of air flow in the equatorial Pacific Ocean. **During an El Niño event, the Walker Circulation is greatly diminished. Increased precipitation and abnormally warm water are found in the central Pacific during an El Niño event (or ENSO warm phase).** These changes in weather patterns have a cascading effect on weather patterns in other parts of the world.

Statement 2 is correct. In normal times, when the tropical south Pacific Ocean (especially near Peru and Chile) experiences high pressure, alternatively the tropical Indian ocean experiences low pressure conditions. However, these pressure conditions are sometimes reversed which results in low pressure in the Pacific and alternatively high pressure in the Indian ocean. This is the periodic change in pressure conditions which is referred to as the Southern Oscillation.

Statement 3 is incorrect. In the Atlantic, **El Niño typically leads to fewer hurricanes.** This is largely due to increased vertical wind shear and more stability in the atmosphere. Wind shear is not good for the development or the sustaining of hurricanes as it rips them apart and a more stable atmosphere prevents the lift required for these storms.

118. Solution: (a)

Exp) Option a is the correct answer.

Thunderstorms form when warm, moist air rises into cold air. The warm air becomes cooler, which causes moisture (water vapor) to form small water droplets through condensation. The cooled air drops lower in the atmosphere, warms, and rises again forming a convection cell. All thunderstorms begin with air rising into the atmosphere to form a convection cell, but the air can be lifted in different ways. There are three basic ingredients needed for thunderstorm development: moisture, an unstable atmosphere, and some way to start the atmosphere moving.

Option 1 is correct: Moisture is necessary to produce the thunderstorm clouds and precipitation. Presence of sufficient moisture in the air can generate thunderstorms at any time of the year, even in extreme winter.

Option 2 is correct: Atmospheric instability also plays an important role in thunderstorm development. **Rising air is needed to produce clouds, and rapidly rising air is needed to produce thunderstorms.** For air to rise rapidly, it must become buoyant compared to the surrounding air. When the atmosphere is unstable, air near the ground can become buoyant and rise rapidly through the atmosphere.

Option 3 is incorrect: Sunlight contributes to the trigger motion in the atmosphere. Trigger motion is some sort of boundary such as a front. Once a thunderstorm has developed, it will continue to generate boundaries that can trigger additional storms. In the summer, thunderstorms typically develop in the afternoon when the sun heats air near the ground.

Important Tips

The amount of moisture in the air and the air temperature determines how often thunderstorms form at a particular location. Geographic location also plays a role. Formation of cumulus clouds, which can lead to thunderstorms, often creates conditions for thunder and lightning to form as electric charges accumulate within the clouds.

119. Solution: (a)

Exp) Option a is the correct answer.

Tropical cyclones are low pressure systems that form over warm tropical waters. It is a rapid rotating storm originating over tropical oceans from where it draws the energy to develop

The conditions favourable for the formation and intensification of tropical storms are:

- A pre-existing weak low- pressure area or low-level-cyclonic circulation.
- Large sea surface with temperature higher than 27° C. **(Hence, option 1 is correct)**
- Presence of the Coriolis force. **(Hence, option 2 is correct)**
- Small variations in the vertical wind speed. **(Hence, option 3 is incorrect)**
- Upper air divergence above the sea level system. **(Hence, option 4 is incorrect)**

Important Tips

Cyclones are rapid inward air circulation around a low-pressure area. The air circulates in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere..

120. Solution: (a)

Exp) Option a is the correct answer.

Tropical cyclones, also known as hurricanes or typhoons, are powerful weather systems characterised by strong winds, heavy rainfall, and storm surge. They form over warm ocean waters and can cause significant damage when they make landfall.

Statement 1 is incorrect: The **eye (not eyewall) of a tropical cyclone is a relatively calm region with clear skies and subsiding air.** The eye is so calm because the **strong surface winds that converge** towards the centre never reach it. The **Coriolis force deflects the wind** slightly away from the centre, causing the wind to rotate around the centre of the cyclone (the eye wall).

Statement 2 is incorrect: The **eyewall (not eye) is a region of intense thunderstorms** surrounding the eye where the **strongest winds and heaviest rainfall occur**. This region experiences powerful updrafts, which draw moisture-laden air upwards, leading to the formation of **towering cumulonimbus clouds** and the release of tremendous amounts of latent heat.

Statement 3 is correct: The place where a **tropical cyclone crosses the coast is called the landfall** of the cyclone. On reaching the land the **moisture supply is cut off and the storm dissipates.** Hence it is true that tropical cyclones **lose their intensity rapidly once they make landfall** due to the lack of warm water as their energy source.

121. Solution: (b)

Exp) Option b is the correct answer.

Thunderstorms and tornadoes are considered as **violent local storms,** occurring over a small area. During these phenomena, the potential and heat energies are converted into kinetic energy. Later, the atmosphere again returns to its stable state.

Statement 1 is incorrect: Thunderstorms are dynamic weather systems associated with **intense updrafts of rising warm air**. This convective mechanism leads to the formation of the **cumulonimbus clouds**. The growth of cumulonimbus clouds in thunderstorms **contributes to precipitation, including rainfall**. When the clouds extend to heights where sub-zero temperature prevails, **hail is formed, and they come down as hailstorm**. Apart from precipitation, thunderstorms **also involve lightning and thunder**. Also, if there is insufficient moisture, a thunderstorm can generate **dust storms**.

Statement 2 is correct: Tornadoes originate from severe thunderstorms. These are characterized by a **descending column of air** that rotates rapidly around a **central low-pressure zone.** The spiraling winds associated with tornadoes can cause significant damage as they touch down to the Earth's surface. **The low pressure at the center contributes to the intensity of the tornado**.

122. Solution: (a)

Exp) Option a is the correct answer.

El Nino and La Nina are complex weather patterns resulting from variations in ocean temperatures in the Equatorial Pacific Region. They are opposite phases of what is known as the El Nino-Southern Oscillation (ENSO) cycle.

Statement 1 is incorrect: El Nino is a complex climatological phenomenon that involves the **unusual warming of the surface waters in the eastern tropical Pacific Ocean**. On the other hand, **La Nina** is the "cool phase" of ENSO and is characterised by the **unusual cooling of the tropical eastern Pacific**. This unusual warming and cooling of the Eastern Pacific Ocean disrupts normal weather patterns and has global climatic effects.

Statement 2 is incorrect: Normally, strong trade winds blow westward across the tropical Pacific, the region of the Pacific Ocean located between the Tropic of Cancer and the Tropic of Capricorn. These winds push warm surface water toward the western Pacific, where it borders Asia and Australia.

During an El-Nino Event westward-blowing trade winds weaken along the Equator. These changes in air pressure and wind speed **cause warm surface water to move eastward along the Equator, from the western Pacific to the coast of northern South America.**

Statement 3 is correct: El Nino can lead to **drier-than-average conditions in the eastern and northern parts of Australia,** which **increases the risk of wildfires.** The phenomenon brings altered rainfall patterns, often resulting in reduced rainfall in certain areas, leading to dry conditions and higher temperatures, conducive to wildfires.

123. Solution: (c)

Exp) Option c is the correct answer.

Cyclones and anticyclones are **large-scale weather systems** that influence **atmospheric circulation and precipitation patterns.**

Statement 1 is incorrect- There are two main types of cyclones: **tropical cyclones and temperate cyclones.** In a tropical cyclone, the central region is referred to as the **'eye,'** characterized by **calm winds and no rainfall.** Conversely, in a **temperate cyclone**, there is **no specific area where winds and precipitation are absent**, and therefore, an **'eye' is not present. Anticyclones** are **high-pressure systems** with **winds rotating outwards**. This outward spiraling **increases pressure and leads to clear skies and calm conditions in the center**. However, there is **no significant pressure drop or formation of an eye** in an anticyclone.

Statement 2 is incorrect- In the **Northern Hemisphere, cyclones display counter-clockwise wind movement,** a result of the **Coriolis effect** induced by the Earth's rotation. The Coriolis effect, strongest at the poles and diminishing towards the equator, deflects moving objects and leads to the inward and counter-clockwise spiral of winds in cyclones. Conversely, **anticyclones in the Northern Hemisphere exhibit clockwise wind movement.**

124. Solution: (b)

Exp) Option b is the correct answer.

Option 1 is *incorrect*: Formation of Fronts (Frontogenesis) requires **Converging Air** so that **one air mass is moved towards another** as **contact** between different air masses is essential for a front to form.

Diverging air circulation leads to **dissipation** of the front (Frontolysis).

Option 2 is correct: A Front by definition, is a **region of instability/ transition** at the **meeting point of two air masses with differing characteristics (like temperature,** humidity, density, etc.). So, for a front to form, there needs to be **2 air masses with contrasting temperatures.**

Option 3 is correct: Coriolis Force is required to **steer the air masses towards each other.** If the air masses remain stationary horizontally, they won't meet and no front would be formed without actual contact.

Important Tips

The temperature contrast influences the thickness of frontal zone in an inversely proportional manner. With a sudden change in temperature through a front, there is a change in pressure also, which is reflected in bending of isobars towards the low pressure. These isobars are otherwise smooth curves. The fronts mostly lie in low pressure troughs. Also, a front experiences wind shift, since the wind motion is a function of pressure gradient and Coriolis force.

125. Solution: (c)

Exp) Option c is the correct answer.

El Nino is a climate phenomenon characterized by the **warming of sea surface temperatures in the central and eastern equatorial Pacific Ocean**. This phenomenon has significant impacts on weather patterns worldwide.

Statement 1 is correct: During **normal conditions** in the Pacific ocean, trade winds (prevailing easterly winds) blow west along the equator, taking warm water from South America towards Asia. **El Niño typically begins with a weakening of the trade winds.** When these winds weaken, it allows warm water in the western Pacific to flow eastward toward the central and eastern Pacific (i.e. towards the Peruvian coast), leading to the warming of sea surface temperatures. This warming characterizes the onset of El Niño. **This hampers the upwelling of cold water at Peruvian coast.**

Statement 2 is correct: As **warm water moves back and forth** across the Pacific Ocean along the equator, **the region where water evaporates most into the atmosphere also changes.** This has a **profound effect on the usual position of the jet stream.** During El Niño, due to warming of eastern-Pacific waters, **the jet stream's position shows a southward shift in the Eastern Pacific.** The intense El-Nino conditions further intensify the Southern shift of Pacific jet stream, which alters the global weather patterns.

Statement 3 is correct: The Humboldt Current, also known as the Peru Current, is a cold current that flows northward from Antarctica towards Peru.

1. Under normal conditions, **strong trade winds** blow from east to west across the Pacific. They **push warm surface water westward**, away from the South American coast, **strengthening the Humboldt Current.**
2. During El Niño, the **Trade winds weaken or reverse.** This weakening reduces the **upwelling**, leading to a **decrease in cold water** reaching the surface and **lessening the overall strength** of the Humboldt Current. Further warm surface water accumulates in the eastern Pacific, near the South American coast. This **warm water can partially warm** the near-surface layer of the Humboldt Current, **further weakening its temperature difference** compared to the surrounding water.

Statement 4 is incorrect: El-Nino has a global impact. However, **not all the regions across the globe faced drought conditions. El-Nino causes drought conditions in India, Indonesia, Australia, and Pacific Northwest also becomes drier.** However, **in the U.S. Gulf Coast and Southeast, these periods are wetter than usual and have increased flooding.** For example, during these conditions, rainfall in California can be significantly above normal, leading to numerous occurrences of flash flood and debris flows.

126. Solution: (b)

Exp) Option b is the correct answer.

A tropical cyclone is a rapidly rotating storm system **characterized by a low-pressure center**, strong winds, and heavy rainfall. These cyclones **typically form over warm ocean waters** near the equator and are **fueled by the latent heat released when moist air rises and condenses.**

Statement 1 is correct: Tropical cyclones, also known as hurricanes or typhoons depending on the region, are

characterized by a well-defined center of low pressure, known as the **eye. The lowest pressure is found in the central region of the cyclone**, particularly within the eye, where **calm conditions prevail.**

Statement 2 is correct: Tropical cyclones are known for their **ability to generate significant amounts of rainfall,** often resulting in widespread flooding and other water-related hazards. The warm, moist air within these storms leads to the **formation of intense convective clouds and heavy precipitation.** As they are typically formed due to convection mechanism, **they generally produce more intense rainfall than temperate cyclones.**

Statement 3 is incorrect: Tropical cyclones **generally move from east to west direction**. Tropical cyclones **in both hemispheres generally exhibit a westward motion**. This motion is primarily driven by the trade winds, which blow from east to west in the tropics. These persistent easterly winds contribute to the westward movement of tropical cyclones. However, they may also undergo a phenomenon, called 'recurvature' where it may rarely move in a northward and an eastward track.

Important Tips

Tropical cyclones **typically form over warm ocean waters** where the **sea surface temperature is around 27 degrees Celsius**. These warm ocean surfaces provide energy needed for the **formation and intensification** of tropical cyclones. On the land, lack of such vast water surfaces prevents the formation of tropical cyclones. Also, once the cyclone **hits the land** (called landfall), it **disrupts the organization and circulation** of the storm system, and the cyclone eventually **weakens and dissipates.**

127. Solution: (d)

Exp) Option d is the correct answer.

El Nino refers to the periodic development of a **warm ocean current along the Peruvian coast** as a temporary replacement for the cold Peruvian Current. The presence of El Nino leads to below average monsoon rainfall in India.

Statement 1 is correct: Walker cells are atmospheric circulation patterns distinguished by upward air motion near the equator and downward air motion in the subtropics. Under normal conditions, trade winds blow east to west across the Pacific Ocean, pushing warm surface water from the eastern Pacific towards the western Pacific. However, when this **circulation weakens, warm water from the western Pacific, typically near Indonesia, shifts eastward towards South America**. This weakening also diminishes the usual upwelling of cooler water along the eastern Pacific coastline. Consequently, the **warm ocean current replaces the cold ocean current along the Peruvian coast**, leading to the occurrence of the El Niño event.

Statement 2 is incorrect: "It is not correct that the positive Indian Ocean Dipole (IOD) exacerbates the adverse effects of El Niño on rainfall patterns in India.". In fact, there are instances where a **positive IOD can partially counteract the adverse effects of El Niño** by increasing rainfall in certain regions of India.

During a **positive IOD phase**, the **western side of the Indian Ocean (near the Somalia coast) becomes warmer** than the eastern Indian Ocean. This temperature gradient influences rainfall patterns in the region, with increased rainfall over regions of India. While negative IOD aggravates the adverse effects of El Nino on the rainfall patterns in India.

Statement 3 is correct: Indonesia experienced a surge in land and forest fires due to the El Niño weather phenomenon recently in September 2023, which is fourfold increase when compared to the 2022 of the same periods.

128. Solution: (b)

Exp) Option b is the correct answer.

La Niña is a climate phenomenon characterized by unusually **cold ocean temperatures in the central and eastern equatorial Pacific.** It is the opposite phase of El Niño and is part of the larger El Niño-Southern Oscillation (ENSO) cycle.**La Niña events typically last 9-12 months** but can persist for up to two years. They occur every 2-7 years, though their intensity varies.

Statement 1 is incorrect: La Niña actually strengthens the trade winds, pushing warmer waters westward across the Pacific. **This results in increased, not decreased, rainfall in Southeast Asia and Australia.** The warmer waters in the western Pacific enhance atmospheric convection and lead to more cloud formation and precipitation.

Statement 2 is incorrect:La Niña typically strengthens the Indian monsoon. The enhanced Walker Circulation, associated with La Niña, helps to strengthen the monsoon winds, which in turn leads to increased rainfall over the Indian subcontinent.

Statement 3 is correct: La Niña strengthens the **easterly trade winds**. These **stronger winds push surface waters westward, causing deeper, colder water to rise to the surface** along the western coast of South America. This process, known as **upwelling**, brings nutrient-rich water to the surface, which can boost marine productivity. Also, this is why the water is **colder than normal along the south american west coast** during a La Niña event.Therefore La Niña usually has a positive impact on the fishing industry of western South America

129. Solution: (d)

Exp) Option d is the correct answer.

When two different air masses meet, the boundary zone between them is called a front, and the process of its formation is known as frontogenesis. There are four main types of fronts: cold front, warm front, stationary front, and occluded front. If an air mass is fully lifted above the land surface, it is called the occluded front

Statement I is incorrect: Rainfall does occur in occluded fronts. Occluded fronts form when a cold front overtakes a warm front, forcing the warm air aloft. This leads to cloud formation and precipitation, often in the form of steady rain or storms.

Statement II is correct: If an air mass is fully lifted above the land surface, it is called the occluded front.

Hence option d is correct: Statement I is incorrect, but Statement II is correct.

130. Solution: (d)

Exp) Option d is the correct answer.

El Nino is a naturally occurring climate pattern **characterized by warming ocean surface temperatures in the central and eastern tropical Pacific Ocean.** El Nino significantly influences global weather patterns, impacting food production, water resources, and overall well-being.

Option 1 is correct: Normally, the **west coast of South America is relatively dry due to the cold Humboldt Current.** During El Niño, this current weakens or reverses, allowing warmer waters to accumulate. **This warm water evaporates, leading to increased moisture and heavy rainfall in the region.**

Option 2 is correct: El Niño disrupts the typical Walker Circulation, a pattern of air movement across the Pacific. During El Niño, the rising air that normally occurs over Indonesia and Australia weakens or shifts eastward. This leads to less rising air, less cloud formation, and consequently, **drier conditions and droughts in Northern Australia.**

Option 3 is correct: Horn of Africa, region of eastern Africa. includes the countries of Djibouti, Eritrea, Ethiopia, and Somalia. The changes in atmospheric circulation patterns caused by El Niño **can lead to increased moisture convergence in this region, resulting in heavier-than-usual rainfall and a higher risk of flooding.**

Option 4 is correct: For India, **El Nino is often linked to weakened Monsoon winds and reduced rainfall** during the monsoon season. This is primarily due to the warming of ocean waters in the central and eastern Pacific which alters wind patterns and prevents moisture-laden clouds from reaching regions in India and Australia.

131. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is Correct: A **tornado** is a **violently rotating column of air** that **extends from the base of a thunderstorm to the ground.**

- Tornadoes are formed from severe thunderstorms when warm, moist air near the surface meets cooler, dry air above, creating instability.
- This instability can lead to spiraling winds that descend from the storm, forming a trunk-like structure resembling an elephant's trunk.
- Tornadoes are characterized by **extremely low pressure** at their center and can cause massive destruction along their path.

Statement 2 is Incorrect: Tornadoes are not restricted to equatorial and tropical regions. While they **do occur in tropical regions, they are more common in temperate areas or mid latitudes** where conditions for severe thunderstorms are ideal.

For example, in the United States, tornadoes frequently occur in the **"Tornado Alley" region**, which spans parts of the central and southern plains, far from the equatorial or tropical zones. **Tornadoes can occur on almost every continent except Antarctica.**

Statement 3 is Correct: Tornadoes can occur over both land and water. When tornadoes form over water, they are known as **waterspouts.** Waterspouts are similar to tornadoes in structure but typically weaker. They often occur in tropical and subtropical waters and can also move onto land, transitioning into land-based tornadoes.

132. Solution: (b)

Exp) Option b is the correct answer.

A cyclone is a large-scale air mass that rotates around a strong center of low atmospheric pressure, counterclockwise in the Northern Hemisphere and clockwise in the Southern Hemisphere.

Option b is correct. The South Atlantic and South-Eastern Pacific are as void of cyclonic activity largely due to the ITCZ having a tendency to stay near or north of the equator.

For a tropical cyclone to occur in South Atlantic and South-Eastern Pacific regions, a broad convergence zone is needed to reach about 5 degrees of latitude away from the equator in order for the Coriolis Force to have sufficient intensity to organize a full-fledged tropical cyclone, and the Atlantic ITCZ almost never shifts that far south.

4.6. Classification of Climates and Climatic Types

133. Solution: (b)

Exp) Option b is the correct answer.

The tropical monsoon climate is one of the key climatic types influenced by seasonal wind patterns. It is characterized by alternating wet and dry seasons due to the shifting of monsoon winds, which dominate these regions.

Statement 1 is incorrect: The tropical monsoon climate is **not found in the south western part of South America or southern Australia.** It is primarily found in regions like South Asia (e.g., India, Bangladesh), Southeast Asia (e.g., Thailand, Vietnam), and **parts of West Africa and northern Australia, and northeastern South America.**

Statement 2 is correct: The tropical Monsoonal Climate region is found between 100 and 250 North and South latitudes. This climatic region is largely confined to the eastern margins of the continents. However, the vast Indian subcontinent is an exception. Complete **seasonal reversal of winds and more than 70% of the total rainfall confined into four months are the outstanding features of these climatic regions.**

Statement 3 is correct: The annual rainfall in tropical monsoon **regions often exceeds 200 cm, with the majority of precipitation occurring during the summer monsoon.** This heavy rainfall sustains agriculture and dense vegetation but also makes these areas prone to flooding.

Statement 4 is incorrect: The monsoonal region experiences high to very high temperatures during summer. The average temperature for the summer months varies from 27 degree Centigrade to 32 degree Centigrade. During the winter months, mercury hovers between 10 degree Centigrade to 26.7 degree Centigrade for non-coastal stations. The temperature in western Rajasthan and some other inland stations may shoot up to 50 degree Centigrade in summer and drop to 0 degree Centigrade in winter. **The annual temperature range is very high and second only (not the highest) to the hot desert climatic region.** The annual temperature range varies from 2 degree Centigrade to 11 degree Centrigrade. The high range of variation is due to continentality, latitude, altitude and cloud cover. The diurnal range of temperature is relatively low in the coastal regions.

134. Solution: (a)

Exp) Option a is the correct answer.

China type of climate is found on the eastern margins of continents in warm temperate latitudes, just outside the tropics. It is typified by a warm moist summer and a cool, dry winters. It can be found in central and north China, including southern Japan. There are various local geological conditions responsible for occurrence of this type of climate.

Statement 1 is correct: The vast landmass of the Asian continent and mountainous regions that lie in the heart of it create great changes in pressure between the winter and summer seasons. It results in a temperate monsoon kind of climate i.e., China type of climate.

Statement 2 is correct: This region also known as the heart of Asia gets intensely heated up in the summers. This intense heating of a wider landmass leads to formation of a low-pressure region.

Statement 3 is incorrect: The creation of low-pressure region causes the moist air stream from the Tropical Pacific to flow in and cause rain in the form of the South-East Monsoon (not south-west monsoon). This contributes to heavy precipitation in the northern and central parts of China, which results in annual rainfall of approximately 100cm.

Statement 4 is incorrect: In winter, a steep pressure gradient is set up between the cold interiors of Mongolia and Siberia. The continental polar air stream flows outwards as the North West Monsoon, bitterly cold and very dry. This results in a great annual temperature range in this type of climate.

135. Solution: (c)

Exp) Option c is the correct answer.

Tundra ecosystems are treeless regions found in the Arctic and on the tops of mountains, where the climate is cold and windy, and rainfall is scant. Tundra lands are covered with snow for much of the year, but summer brings bursts of wildflowers.

Statement 1 is correct: The tundra biome is a cold, **treeless plain where harsh conditions make survival difficult for both plants and animals.** Tundra vegetation is composed of dwarf shrubs, sedges, grasses, mosses, and lichens. Scattered trees grow in some tundra regions. The ecotone (or ecological boundary region) between the tundra and the forest is known as the tree line or timberline. The tundra soil is rich in nitrogen and phosphorus.

Statement 2 is incorrect: Human impact in the tundra biome is most obvious in the **exploration and development of mining,** oil, gas, and other extractive industries.

There is no blanket ban on extraction and mining activities in the Tundra region around the World.

Statement 3 is correct: The Tundra plays a significant part in the planet's temperature management. It works as a carbon sink, absorbing carbon dioxide from the atmosphere and assisting in the mitigation of the negative impacts of carbon emissions.

Important Tips

Tundra climate is a Köppen climatic type with sub-freezing mean annual temperatures, large annual temperature ranges (albeit not as large as the adjacent continental subarctic climate), and moderately low precipitation. It is known for its frost-molded landscapes, extremely low temperatures, little precipitation, depleted nutrients, and short growing seasons.

136. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: British Type Climate is also called as Cool Temperate Western Margin Climate. They are under the influence of the Westerlies all-round the year. They are the regions of frontal cyclonic activity or Temperate Cyclones. Rainfall occurs throughout the year. **The natural vegetation of this climatic type is deciduous forest.** The deciduous trees occur in pure stands and have greater lumbering value. **The climate is ideal for maximum comfort and mental alertness.**

Option b is incorrect: Warm Temperate Eastern Margin Climate is also called as China Type Climate. Characterized by a warm moist summer and a cool, dry winter. There is fairly uniform distribution of rainfall throughout the year. Local storms like typhoons and hurricanes occur here.

Option c is incorrect: Temperate Continental/Grassland Climate is also called as Steppe Climate. They lie in the Westerly wind belt, and in interiors of the continents. Grasslands are practically treeless due to continentality. Grasses are tall, fresh and nutritious and are ideal for extensive wheat cultivation. Temperatures vary greatly between summer and winter. The steppe type of climate in the southern hemisphere is never severe.

Option d is incorrect: Cool Temperature Continental climate is also called as Siberian Climate. The Siberian Climate is absent in the southern hemisphere because of the narrowness of the southern continents. The vegetation is predominantly evergreen coniferous forest. It stretches in a great, continuous belt across North America, Europe and Asia. The greatest single band of the coniferous forest is the

taiga in Siberia. The climate is characterized by a bitterly cold winter of long duration, and a cool brief summer.

137. Solution: (c)

Exp) Option c is the correct answer.

Steppes are a class of regions characterized by vast, wide-open grasslands. In this area, trees are generally absent, except near lakes or rivers. The climate of the steppes differs from region to region. Steppe biomes comprise the montane grasslands and shrub lands biome and the temperate grasslands, savannas, and shrub lands biome.

Pair 1 is correct: The **Hungarian Puszta** is a temperate grassland biome of the Alfold or Great Hungarian Plain. It is an exclave of the Eurasian Steppe and lies around the river Tisza in the eastern part of Hungary, as well as in the western part of the country and in the Burgenland of Austria.

Pair 2 is incorrect: The **prairies** are temperate **grasslands of North America**. They are enormous stretches of flat grassland with moderate temperature, moderate rainfall, and few trees and in the middle of North America they are usually golden, wheat-covered land.

Pair 3 is incorrect: The **Pampas** grassland is found in **South America**. Pampas are the temperate grasslands of Argentina.

Pair 4 is correct: The **Canterbury grasslands** is an ecoregion of the South Island, **New Zealand,** part of the wider tussock grasslands of New Zealand. This type of Grassland is frequently found between woods and desert.

Pair 5 is correct: The temperate grasslands of **South Africa** are called the **Velds**. The Velds have a mild climate due to the influence of the Indian Oceans. The vegetation cover is sparse, with red grasses growing in the bush Velds and acacia and maroola growing in the high Velds.

138. Solution: (b)

Exp) Option b is the correct answer.

Temperate grasslands are found in the regions with temperate and semi-arid to semi-humid climates. The Veldts of South Africa, the Puszta of Hungary, the Pampas of Argentina and Uruguay, the Steppes, and the plains and Prairies of Central North America are Temperate Grasslands

Statement 1 is incorrect. In the northern hemisphere, the climate of Temperate grasslands is continental with a high range of annual temperature. Temperate grassland in the northern hemisphere is extensive and continental.

In the southern hemisphere, the climate is never severe. It is mainly due to the narrowness of the temperate portions of the southern continents. Here, **the annual range of temperature is very low.** Temperate grassland in the southern hemisphere is restricted and less continental i.e., their annual range of temperature is very low.

Statement 2 is correct. The tropical savanna climate is also called the tropical wet and dry climate. It is the climate experienced in savanna or tropical grassland regions of the world. These places are located near the equator, and they lie between the Southern and the Northern Tropics.

Savanna (or Sudan) type of climate has alternate hot, rainy season and cool, dry seasons but has considerably less annual rainfall. It is confined within the tropics and is best developed in Sudan, hence its name the Sudan Climate. It is a transitional type of climate found between the equatorial rainforests and hot deserts. Other features of this climate are:

- Mean annual temperature is greater than 18° C.
- Highest temperatures do not coincide with the period of the highest sun (e.g. June in the northern hemisphere) but occur just before the onset of the rainy season, i.e. April in Northern Hemisphere and October in Southern Hemisphere.
- This **extreme diurnal range of temperature** is another characteristic feature of this climate with days being hot and nights being cold.
- The prevailing winds of the region are the **Trade Winds,** which bring rain to the coastal districts.

139. Solution: (b)

Exp) Option b is the correct answer

Koeppen's scheme of classification of climate is an empirical classification based on mean annual and mean monthly temperature and precipitation data. Koeppen recognised five major climatic groups namely A, B, C, D and E. Four of them are based on temperature and one on precipitation.

Option a is incorrect: Group A consists of tropical humid climates. It exists between Tropic of Cancer and Tropic of Capricorn. The sun is present overhead throughout the year and the presence of Inter Tropical Convergence Zone (ITCZ) make the climate hot and humid. **It has low annual range of temperature and high annual rainfall.** The tropical group is divided into three types, namely

(i) Af- Tropical wet climate

(ii) Am - Tropical monsoon climate

(iii) Aw- Tropical wet and dry climate.

Option b is correct: Warm temperate (mid-latitude) climates constitute as Koeppen's type C climate. It extends from 30° - 50° of latitude on the eastern and western margins of continents. **These climates generally have warm summers with mild winters.** They are grouped into four types:

(i) Humid subtropical, i.e., dry in winter and hot in summer (Cwa)

(ii) Mediterranean (Cs)

(iii) Humid subtropical, i.e., no dry season and mild winter (Cfa)

(iv) Marine west coast climate (Cfb)

Option c is incorrect: Dry climate is grouped under type B as per Koeppen's classification. It is characterised by very low rainfall that is not adequate for the growth of plants. These climates cover a very large area of the planet extending over large latitudes from 15° - 60° north and south of the equator. Dry climates are divided into steppe or semi-arid climate (BS) and desert climate (BW).

Option d is incorrect: Cold snow forest climates comes under group D. It is further sub divided into Df- cold climate with humid winter and Dw- cold climate with dry winter. Climate with humid winter has winters that are cold and snowy. The frost-free season is short. **The annual ranges of temperature are large. The weather changes are abrupt and short.** Towards the pole, winters are more severe.

140. Solution: (d)

Exp) Option d is the correct answer.

The characteristics of Equatorial Regions are as follows.

Option 1 is correct: There is high average temperatures and humidity throughout the year.

Option 2 is correct: Prevalence of Bacteria and Insect Pests: The hot, wet climate which stimulates rapid plant growth also encourages the spread of insects and pests. Insects and pests not only spread diseases but are injurious to crops.

Option 3 is correct: Poor quality of soil: The region has poor soil because of the amount of rain in the area.

Option 4 is correct: Presence of Dense Forest: The Forest is so dense that it is quite a problem to clear a small patch of it and even more difficult to maintain it.

Option 5 is correct: Commercial extraction of Timber is difficult. The trees do not occur in homogenous stands, there are no frozen surfaces to facilitate logging and the tropical hardwoods are sometimes too heavy to float in the rivers.

141. Solution: (c)

Exp) Option c is the correct answer.

Commercial Grain Farming is an **extensive agricultural activity whereby crops are grown for commercial purposes.** Most commercial grains are wheat and maize. It is **mostly practiced in temperate grasslands of North America, Europe and Asia.**

Commercial grain farming of wheat

There are **four major areas** in the world known for extensive commercial farming of wheat. These are US and Canadian Prairies; Eurasian Steppes; Argentine Pampas **and** Downs of Australia.

Option 1 is correct. American Canadian prairies experience dry semi-arid climates with an annual precipitation of 12 to 15 inches which is suitable for commercial grain cultivation.

Option 2 is correct. European steppes are the largest temperate steppe and experience semi-arid climate which is best for commercial grain cultivation.

Option 3 is correct. Pampas of Argentina is also semi-arid region. Wheat is Argentina's largest crop in harvested land area.

Option 4 is incorrect: The Amazon Basin is the **largest tropical forest in the world.** Extensive commercial agriculture or extensive grain cultivation is not practiced here. Mostly people practice **shifting cultivation** here.

142. Solution: (a)

Exp) Option a is the correct answer.

The Mediterranean climate, known for its distinctive weather patterns, plays a significant role in shaping the environments of certain regions. This climate type is characterized by specific temperature and precipitation characteristics that create unique seasonal variations.

Statement 1 is correct: Mediterranean climate is mostly found on the western coast of the continents in the sub-tropical latitudes. Regions bordering the **Mediterranean Sea** itself, parts of **California, central Chile, South Africa, and parts of Australia** are examples of areas exhibiting a Mediterranean climate.

Statement 2 is incorrect: The areas under the Mediterranean climate come under the influence of sub-tropical highs in summer and westerly winds in winter. Hence, the climate is characterized by hot, **dry summers and** mild, **rainy winters.** This seasonal contrast contributes to the region's distinct climate and influences various aspects of ecosystems, agriculture, and human activities.

Statement 3 is incorrect: The Mediterranean climate is **not associated with heavy annual precipitation.** Instead, it is characterized by a distinct dry season, particularly in the summer. The **annual precipitation ranges between 35 - 90 cm.** Hence, the statement given is incorrect.

143. Solution: (d)

Exp) Option d is the correct answer.

The tropical monsoon climate is characterized by distinct wet and dry seasons. In these regions, **Temperatures range from 30-45° C in summer.** In winters, the mean temperature will be around 20-25° C. **Annual mean rainfall ranges from 200-250 cm. In some regions, it is around 350 cm.** Heavy rainfall occurs mostly in summer and winters are usually dry.

Option 1 is correct: The **Northern Coast of Australia** experiences tropical monsoon climate. This includes regions like **Queensland and the Northern Territory**

Option 2 is correct: Countries in **South Asia** like **India, Bangladesh, and Sri Lanka** are known for tropical monsoon climates. These regions have distinct wet and dry seasons influenced by the monsoon winds.

Option 3 is correct: Countries in **Southeast Asia like Thailand, Myanmar, Vietnam, Laos, Cambodia and parts of Indonesia** exhibit tropical monsoon climate.

Option 4 is correct: The **northern and northeastern parts of South America,** including countries like **Venezuela, Guyana, and parts of Columbia and Ecuador,** can have tropical monsoon climate with distinct wet and dry seasons.

144. Solution: (c)

Exp) Option c is the correct answer.

The tundra climate stands as a testament to the extreme environmental conditions prevalent in polar regions. Known for its distinctive vegetation, **such as low-growing mosses, lichens, and flowering plants, the tundra climate is associated with permafrost, where the subsoil remains perpetually frozen.** In this challenging environment, the short growing season and waterlogging support only modest plant growth.

Statement 1 is incorrect: The tundra climate is prevalent in the **polar regions of both the Northern as well as Southern Hemisphere.** It is found in the regions north of the Arctic Circle and south of the Antarctic Circle. Further, the tundra climatic features extend to North America, Europe, and Siberia in Asia.

Statement 2 is incorrect: The tundra climate experiences a **phenomenon known as the "midnight sun" during summer**, where the sun remains above the horizon for an extended period. **So, tundra regions in summer exhibit a very significant and prolonged duration of daylight.** During the height of summer in these regions, one can see the sun at the local time of midnight, which means it never gets dark. This is because during summers in the Northern Hemisphere, the axis of Earth is tilted towards the Sun. The same phenomenon is applicable in the Southern Hemisphere as well. **Hence, the statement given is incorrect.**

Statement 3 is incorrect: Rubber trees belong to the tropical evergreen type of vegetation and not to the Tundra type of vegetation.

145. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: The equator receives nearly the same amount of daylight and darkness throughout the year. This results in a relatively consistent climate without significant seasonal variations.

Statement 2 is incorrect: The Earth's rotational velocity is maximum at the equator, but this does not affect the seasons.

146. Solution: (b)

Exp) Option b is the correct answer.

Monsoon refers to the seasonal change in the direction of the prevailing winds of a region. Monsoons cause wet and dry seasons throughout much of the tropics. Monsoons are most often associated with the Indian Ocean. Monsoons always blow from cold to warm regions. The summer monsoon and the winter monsoon determine the climate for most of India and Southeast Asia.

147. Solution: (c)

Exp) Option c is the correct answer.

Continentality is the main reason behind the high annual range of temperature difference between steppes of the northern and southern hemisphere. Due to continentality, winters are very cold in the north, but due to **maritime influence in the south, winters are mild**. Thus, this brings a great difference in annual range of temperature. Also due to continentality, conventional rainfall occurs in the region. And rainfall in winter is caused by occasional depressions of the westerlies.

148. Solution: (b)

Exp) Option b is the correct answer.

The **Cool Temperate Eastern Margin (Laurentian) Climate** is an intermediate type of climate between the British and the Siberian type of climate. It has features of both the maritime and the continental climates. It is **characterized by cold, dry winters and warm, wet summers.** Winter temperatures is below freezing point and snow fall is quite natural. Rainfall occurs throughout the year with summer maxima. The predominant vegetation of the Laurentian type of climate is cool temperate forest. The heavy rainfall, the warm summers and the damp air from fogs, all favour the growth of trees. Generally speaking, the forest-tend to be coniferous north the 50°N. parallel of latitude.

The increase in the length and severity of the winter excludes forests that are not adaptable to cold conditions. In the Asiatic region (eastern Siberia and Korea), the coniferous forests are, in fact, a continuation of the great coniferous belt of the taiga.

Laurentian type of climate is found only in two regions and that too only in the northern hemisphere because in the southern hemisphere only a small section of southern continents extends south of 40-degree latitude.

It is found on North American region (Eastern Canada, north-east U.S.A., and Newfoundland.) and Asiatic region (Siberia, North China, Manchuria, Korea and northern Japan).

149. Solution: (c)

Exp) Option c is the correct answer.

Cold ocean currents contribute to the formation of coastal deserts. A coastal desert may be almost totally rainless, yet damp with fog. Apart from the presence of cold oceanic current other factors like air subsidence, offshore trade winds etc. are also responsible for desert formation in eastern part of continent in sub-tropical area.

Option 1 is correct: The **Namib Desert is a result of the Benguela Current**, a cold current that flows from south to north along the western coast of South Africa. The current causes seamounts to force the icy Benguela River to flow close to the Namibian coast, creating a harsh climate with little rainfall.

The Benguela Current also helps in forming the Kalahari Desert. The current flows from south to north along the western coast of South Africa, contributing to the formation of the South Atlantic drift.

Option 2 is correct: The **Canary Current is a cold ocean current** that flows off the northwest coast of Africa and has contributed to the **creation of the Sahara Desert**. The Canary Current's cool waters help moderate the temperatures in the coastal region, making it cooler than the rest of the Sahara Desert. The Canary Current also intensifies rainless conditions in the coastal region of the Sahara Desert.

Option 3 is correct: The **Humboldt Current, also known as the Peru Current, contributes to the formation of the Atacama Desert**. The Humboldt Current flows along the southwestern coast of South America, making coastal winds cold and unable to carry moisture. This contributes to the desert's aridity.

Option 4 is incorrect: The **Gobi Desert is a rain shadow desert**, formed by the Himalaya range. Gobi is located in

the rain shadow of the Himalayas, making it extremely dry. It is not created by the influence of cold current. The **Gobi Desert is formed due to continentality**, which is a place located far away from the sea and does not have any rainfall.

150. Solution: (c)

Exp) Option c is the correct answer.

The Warm Temperate Western Margin Climate (also known as Mediterranean climate) is found in relatively few areas in the world. They are entirely confined to the western portion of continental masses, between 30° and 45° north and south of the equator. The basic cause of this type of climate is the shifting of the wind belts.

Statement-I is correct: In the Mediterranean regions, most of the rain falls in winter because of the Westerlies blowing towards the equator. These winds bring **heavy rain from the Atlantic to the Mediterranean countries** during this time, making winter the rainy season in the Mediterranean Climate. This is different from many other climates where the most rain falls in summer.

Statement-II is incorrect: Mediterranean regions come under the influence of subtropical high in summer and westerly wind in winter. **In summer,** when the sun is directly overhead at the Tropic of Cancer, **the Mediterranean regions are less likely to experience rain-bearing westerlies.** Instead, the prevailing **Trade Winds (Tropical easterlies) blow offshore,** resulting in minimal rainfall during summer. However, in **winter**, the subtropical high-pressure system shifts equatorward, enabling **the rain bearing on shore westerlies to exert dominance over the Mediterranean region.**

151. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: China type, Natal type and the Gulf type climate types occur on the eastern margin of the continents. It is collectively known as the warm temperate eastern margin climate.

1) **China type** climate occurs on the **eastern margin of Asia (particularly China and Japan).** It is a modified monsoonal climate known as the **Temperate Monsoon or China Type.**
2) **Natal type** climate occurs on **the eastern margin of Southern Africa, Australia and South America (Southern Brazil, Paraguay, Uruguay and Northern Argentina)** where it is influenced by onshore Trade Winds all year round, without significant monsoon variations.
3) **Gulf type** climate occurs on the **eastern margin of North America (Southeastern United states).** It is called the Gulf type due to influences from the Gulf of Mexico.

Statement 2 is incorrect: China type of climate typically exhibits a great annual temperature range rather than a small one (upto 45-degree F). This variation in temperature is largely influenced by its monsoonal characteristics, where distinct wet and dry seasons result in pronounced temperature differences between summer and winter.

However, the Natal and Gulf climates are characterized by narrower annual temperature ranges **(13 to 19-degree F).** The warm gulf stream and the onshore trade winds bring a narrow range of temperature in Gulf type climate. Where the narrowness of continents and maritime influence, and influence of southeast trade winds cause small annual temperature range in Natal type.

Statement 3 is incorrect: The **China type of climate exhibits wet summer and dry winters,** experiencing around one third of annual rainfall in just summers. The **Gulf type of climate experiences majority of the rainfall in summers, however there is no distinct dry period** like China type. Some regions in the Gulf type of climate like Alabama, experiences intense rainfalls in winters due to cyclonic activities. On the other hand, the **southeast trade winds bring even distribution of rainfall throughout the year in the Natal type of climate.**

Statement 4 is correct: All three climate types - China type, Natal type, and Gulf type - share the characteristic of experiencing a strong maritime influence. Being situated along coastlines or near large bodies of water. They are influenced by maritime climates, which contribute to milder temperatures, higher humidity, and other oceanic influences on their weather patterns.

152. Solution: (c)

Exp) Option c is the correct answer.

Grassland ecosystems are found in regions where rainfall is about 25-75 cm per year. This rainfall is not enough to support a forest, but it is more than the rainfall received in a true desert. These regions are dominated by grass and there are two types of grasslands namely tropical grasslands and temperate grasslands.

Options 1,2,3 and 4 are correct: The temperate grasslands are known as **prairie in North America, steppes in Asia and pampas in South America.** In Australia, these grasslands cover a huge part of the country and are referred to as **'Downs'.**

Options 5 and 6 are incorrect: Tropical grasslands have dry and wet seasons that remain warm all the time, in contrast the temperate grasslands have cold winters and warm summers with some rain. **Llanos are tropical grasslands found in Venezuela and Colombia** region of South America, whereas **Campos** is the **tropical grasslands found in the Argentina** region of South America.

153. Solution: (a)

Exp) Option a is the correct answer.

High temperature and abundant rainfall in the equatorial regions support a luxuriant type of vegetation-the tropical rainforests. These forests thrive in regions that receive more than 200 cm of rainfall, accompanied by a short dry season.

Statement 1 is correct: Equatorial vegetation is characterized by their complex structure, consisting of tall, broad-leaved evergreen trees forming the **upper canopy.** The smaller trees beneath form the next layer, and the **ground is**

rooted with ferns and herbaceous plants which can tolerate shade. **This distinctive layered arrangement of vegetation due to the competition for sunlight.**

Statement 2 is incorrect: In contrast to temperate forests, where only a few species dominate a given area, tropical rainforests boast a remarkable diversity. For example, in places like the **Malaysian jungle**, it's estimated that an acre of forest may contain up to 200 species of trees. This rich biodiversity poses challenges for commercial timber exploitation. Further tropical hardwoods do not float easily on water, making transportation costly. For these reasons numerous tropical countries find themselves net importers of timber.

Statement 3 is incorrect: Sandalwood and bamboo are primary commercial tree species in the tropical deciduous forests (not equatorial evergreen forests). Apart from teak and bamboo, deciduous forests host tree species like Sal, shisham, sandalwood, khair, Kusum, arjun, and mulberry. Meanwhile, equatorial **evergreen forests are home to significant trees such as ebony, mahogany, rosewood, rubber, and cinchona.**

154. Solution: (c)

Exp) Option c is the correct answer.

The **Equatorial Climate** is characterized by warm temperatures, high humidity, and abundant rainfall throughout the year. It is primarily found in regions near the **equator**, such as the Amazon Basin, the Congo Basin, and parts of Southeast Asia

Option 1 is correct: A regular **pattern of land and sea breezes is a characteristic feature** of an Equatorial climate, contributing to the relatively stable and equable temperature conditions in this region throughout the day and year.

Option 2 is incorrect: The **diurnal range of temperature** (difference between day and night temperatures) in equatorial regions is **low**. Due to consistent cloud cover and high humidity, temperatures remain relatively **constant** throughout the day and night.

Option 3 is correct: The equatorial climate does **not** experience distinct seasons like winter. Instead, **temperatures remain high throughout the year**, usually between **25°C and 30°C**. There is **no winter season** because the Sun is almost directly overhead year-round, ensuring constant warmth.

Option 4 is correct: One of the key features of the equatorial climate is **heavy rainfall throughout the year**, often exceeding **2000 mm annually**. This occurs due to **convectional rainfall**, where intense heating causes warm, moist air to rise, leading to cloud formation and daily thunderstorms.

155. Solution: (a)

Exp) Option a is the correct answer.

The **British Type Climate**, also known as the **Cool Temperate Oceanic Climate**, is predominantly found along the **western coastal regions** of continents between **40° and 60° latitudes**.

Statement 1 is correct: The **British Type Climate**, also known as the **Cool Temperate Oceanic Climate**, is found along the **western coastal regions** of continents between **40° and 60° latitudes.** This climate type is characteristic of regions such as: Western Europe (e.g., UK, Ireland, France), Western North America (e.g., Pacific Northwest, Canada). Regions such as **Southern Chile and Tasmania experience this type of climate due to their proximity to the ocean and the influence of westerly winds.**

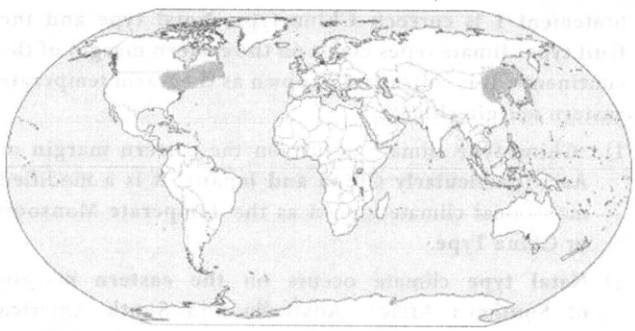
Statement 2 is correct: The **Westerlies**, or **prevailing westerly winds**, dominate this climate throughout the year. These winds originate from the **subtropical high-pressure belt** and move towards the **polar low-pressure belt**, carrying moisture from the ocean to the land. This results in **consistent precipitation** and moderate temperatures.

Statement 3 is incorrect: The vegetation in British Type Climate region mainly consists of deciduous trees, such as oak, beech, and maple, which **shed their leaves in autumn** to conserve energy for the winter months.

156. Solution: (c)

Exp) Option c is the correct answer.

- The Laurentian type climate, also known as the subarctic climate, is characterized by cold winters and cool summers.
- Winters are long and harsh, with temperatures often falling below freezing, while summers are short and mild.
- Precipitation is relatively low, mostly in the form of snow during winter.
- Vegetation in this climate typically includes boreal forests (taiga), with coniferous trees such as pine and spruce.
- This climate is influenced by its high latitude, resulting in extreme seasonal variations in temperature.



It is found in Northeastern North America, including eastern Canada, North East USA (Maritime Provinces and **New England state**), and **Newfoundland**. In Asia, it is found in eastern coastal lands including Eastern Siberia, Eastern China, **Manchuria**, Korea, and northern Japan.

Option 1 is correct. Newfoundland in Canada experiences the Laurentian type of climate.

Option 2 is incorrect. The Mediterranean type of climate is prevalent in **California**.

Option 3 is correct. Manchuria in China experiences the Laurentian type of climate.

Option 4 is correct. New England in the US experiences the Laurentian type of climate.

157. Solution: (c)

Exp) Option c is the correct answer.

The warm temperate western margin (Mediterranean region) is also called as dry summer subtropical climate. It is entirely confined to the western portion of the continental masses between 300C-450C North and South. There are five regions of the world having the Mediterranean climate these are: the borderlands of the Mediterranean sea (north of the Mediterranean sea from Portugal to Turkey and Beyond of Iranian Highlands; the southern borderland includes Morocco, Northern Algeria, Tunisia and North of Bengasia in Libya); the central and southern California coast in the USA; Central Chile; The Cape town area of South Africa; South and south-western coast of Australia. This climatic region occupies only 1.7% of the total land area of the world. The Mediterranean is the only climatic region of the world that receives rainfall only in winter.

Only options 1, 3 and 5 are correct. The Mediterranean type of climate is found in:

1. **The central and southern California coast in the USA,**
2. **Central Chile,**
3. **South and south-western coast of Australia,**
4. **Mediterranean region**
5. **The Cape town area of South Africa**

The basic cause of this climate is the shifting of the wind belts. These areas come under the influence of subtropical high in summer and westerly wind in winter. Hence, the climate is characterised by hot & dry summers and mild, rainy winters. Monthly average temperature in summer is around 25° C and in winter below 10°C. The annual precipitation ranges between 35 - 90 cm. The Mediterranean region receives most of their precipitation in winter when the Westerlies shift equatorwards.

Option 2 is not correct. In Newfoundland, Laurentian climate is found. The cool temperate eastern margin Laurentian climatic region occurs on the eastern side of North America between 35 degree and 55 degree North. It is found in Northeastern North America, including eastern Canada, North East USA (maritime provinces and New England state), and Newfoundland. In Asia, it is found in eastern coastal lands including Eastern Siberia, Eastern China, Manchuria, Korea, and northern Japan.

Option 4 is not correct. In southern Chile, The Cool Temperate Western Margin climate or the British type of climate is found. These are the regions which remain under the permanent influence of the Westerlies all-round the year. In the northern hemisphere, it is experienced in Britain, northern and western France, Belgium, the Netherlands, Denmark, western Norway and northwestern Iberian Peninsula.

In the southern hemisphere, this climate is experienced in **southern Chile, Tasmania and New Zealand.**

158. Solution: (a)

Exp) Option a is the correct answer.

A humid subtropical climate lies on the eastern parts of the continent in subtropical latitudes. In this region the air masses **are generally unstable and cause rainfall throughout the year.** They occur in the **eastern United States of America, southern and eastern China, southern Japan, northeastern Argentina, coastal south Africa and eastern coast of Australia.** The **annual averages of precipitation vary from 75-150 cm.** Thunderstorms in summer **and frontal precipitation in winter are common.** The mean monthly temperature in summer is around 27°C, and in winter it varies from 5°-12° C. **The daily range of temperature is small.**

159. Solution: (a)

Exp) Option a is the correct answer.

Statement I is correct: The **Cool Temperate Continental (Siberian) Climatic Region is found only in the Northern Hemisphere.** On the poleward side, it merges into the Arctic tundra of Canada and Eurasia; at around the Arctic Circle southwards it fades into the temperate Steppe climate. This climatic region is characterised by several winters of long durations, and cool brief summers. The warmest month has a temperature of 10 degree centigrade while the winter months are always below the freezing point. It receives 62cm of annual average rainfall. Siberia is often referred to as the cold pole of the earth. Verkhoyansk in Siberia is the coolest place on the earth. Taiga forest dominates this climatic region.

Statement II is correct and is the correct explanation of statement I: The **Siberian Climate is absent in the southern hemisphere because of the narrowness of the southern continents in the high latitudes.** The strong oceanic influence reduces the severity of the winter and coniferous forests are found only on the mountainous uplands of southern Chile, New' Zealand, Tasmania and south-east Australia. On the other hand, the Northern Hemisphere is characterized by a broad east-west spread of continents in the high latitudes.

160. Solution: (d)

Exp) Option d is the correct answer.

Row 1 is correctly matched: The **British Type Climate (also known as the Marine West Coast Climate)** is characterized by mild temperatures and **rainfall throughout the year, with a slight maximum in winter or autumn. New Zealand, particularly the South Island, experiences this type of climate due to its proximity to the ocean and influence of westerly winds.**

Row 2 is incorrectly matched: The **Savannah** or Sudan climate is a transitional type of climate found between the equatorial forests and the trade wind hot deserts. The belt includes West African Sudan and then curves southwards into East Africa and southern Africa north of the Tropic of Capricorn. It is **characterized by an alternate hot, rainy season and cool dry season.**

The **Equatorial type of climate most distinguishing feature is its great uniformity of temperature** throughout the year. Its extent is found in the lowlands of Amazon, **Congo**, malaysia and the East Indies.

Row 3 is correctly matched: The **Cool Temperate Eastern Margin (Laurentian) Climate** is an intermediate type of climate between the British and the Siberian type of climate. It has features of both the maritime and the continental climates. It is apparent from that the Laurentian type of climate is found only in two regions. One is north-eastern North America, including eastern Canada, north-east U.S.A., (i.e. Maritime Provinces and the New England states), and **Newfoundland**. This may be referred to as the North American region. The other region is the eastern coastlands of Asia,including eastern Siberia. North China. Manchuria. Korea and northern Japan.

The **Laurentian type of climate has cold, dry winters and warm, wet summers.**

161. Solution: (d)

Exp) Option d is the correct answer.

A front is a weather system that is the boundary separating two different types of air. One type of air is usually denser than the other, with different temperatures and different levels of humidity.

Statement 1 is correct. A cold front is defined as the transition zone where a cold air mass is replacing a warmer air mass. **Cold fronts often come with thunderstorms or other types of extreme weather.** They usually move from west to east. Cold fronts move faster than warm fronts because cold air is denser, meaning there are more molecules of material in cold air than in warm air.

Statement 2 is correct. Stationary fronts will either dissipate after several days or devolve into shear lines. But can **change into a cold or warm front** if conditions aloft change causing the **stronger** of the two fronts to win out. Else, the stationary front will be pushed in one direction by another stronger front pushing behind it.

Statement 3 is correct. An occluded front is formed during the process of **cyclolgenesis** when a **cold front overtakes a warm front**. When this occurs, the warm air is separated (occluded) from the cyclone centre at the earth's surface. While frontogenesis is the atmospheric process that leads to the formation or intensification of fronts is Galled frontogenesis

162. Solution: (c)

Exp) Option c is the correct answer..

Warm Temperate Western Margin climate, aka Mediterranean type climate is found in few areas of the world. It is entirely confined to the western portion of continental masses, between 30° and 40° north and south of equator. The basic cause of this type of climate is shifting of wind belts.

The Mediterranean type climate is characterised by very distinctive climatic features – a dry and hot summer with off-shore trades and a concentration of rainfall in winter with on-shore westerlies.

163. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct. Mid-latitude deserts occur between 30° and 50° N. and S., poleward of the subtropical high-pressure zones. **These deserts are in interior drainage basins far from oceans and have a wide range of annual temperatures.** The Sonoran Desert of southwestern North America is a typical midlatitude desert.

Statement 2 is correct. Rain shadow deserts are formed because tall mountain ranges prevent moisture-rich clouds from reaching areas on the lee, or protected side, of the range. As air rises over the mountain, water is precipitated and the air loses its moisture content. A desert is formed in the leeside "shadow" of the range. The Turpan Depression is the rain shadow desert of the Tian Shan of China.

Statement 3 is correct. Coastal deserts generally are found on the western edges of continents near the Tropics of Cancer and Capricorn. **They are affected by cold ocean currents that parallel the coast.** Because local wind systems dominate the trade winds, these deserts are less stable than other deserts. A coastal desert, the Atacama of South America, is the Earth's driest desert. **They cool the air and make it harder for the air to hold moisture. Most moisture falls as rain before it reaches the land, eg the Namib Desert in Africa.**

The trade winds in two belts on the equatorial sides of the Horse Latitudes heat up as they move toward the Equator. These dry winds dissipate cloud cover, allowing more sunlight to heat the land. Most of the major deserts of the world lie in areas crossed by the trade winds. The world's largest desert, the Sahara of North Africa.

164. Solution: (b)

Exp) Option b is the correct answer.

In hot and dry deserts, also known as arid deserts, the temperatures are warm and dry year-round. Some famous arid deserts include the Sahara Desert.

Cold deserts are still dry but have extremely low temperatures in comparison to the other types of deserts. The Antarctic is an example of a cold desert.

Statement 1 is incorrect. Cold deserts are also found in mid latitudes. Gobi Desert is a mid-latitude desert. The mid-latitude desert is an excessively dry region with an arid climate located between 30 degrees and 60 degrees north and south of the equator. Cold deserts are also found in Tropical area. For example, Ladakh region has a cold desert in India. The Tibetan Plateau, a rain shadow in Tibet, China, and India has the Himalayan mountain range to thank for its dry climate.

Statement 2 is correct. Sand dunes are not prominent features in cold deserts, but snow dunes occur commonly in areas where precipitation is locally more abundant.

4.7. Natural Vegetation

165. Solution: (d)

Exp) Option d is the correct answer.

Desert vegetation has evolved unique structural and physiological adaptations to survive extreme arid conditions characterized by **high temperatures, low precipitation, intense sunlight, and nutrient-poor soils**. Plants in deserts must minimize water loss, efficiently absorb moisture, and endure prolonged droughts.

Statement 1 is correct. One of the primary adaptations of desert vegetation is the **development of specialized root systems** to maximize water absorption. Certain plants, such as **mesquite trees**, have **deep taproots** that can extend **over 30 meters (100 feet) underground** to tap into deep water reserves. Other plants, such as **cacti and succulents**, develop **shallow but widespread lateral root systems** that extend **several meters** from the base of the plant. These roots quickly absorb moisture from light rainfall before it evaporates from the soil.

Statement 2 is correct. Many desert plants exhibit **succulence**, where they **store water in their stems, leaves, or roots** to endure prolonged dry periods. Succulent plants, such as **cacti and aloe vera**, have **thick, fleshy stems** that function as water reservoirs. These plants also have **a waxy cuticle covering their stems**, which helps reduce water loss by preventing transpiration.

Statement 3 is correct. Desert plants have evolved **seeds with tough outer coatings**, allowing them to remain **dormant for extended periods** until favorable conditions, such as sufficient rainfall, occur. This adaptation ensures that germination happens only when there is enough moisture to support seedling growth. The impermeable seed coat protects the embryo from extreme heat, dryness, and predation, **ensuring long-term survival in the seed bank** until suitable conditions trigger germination.

166. Solution: (a)

Exp) Option a is the correct answer.

Two of the important factors determining plant growth are temperature and precipitation.

Pair 1 is incorrect – Most favorable climate for Olive is the Mediterranean type of climate, that is, warm temperate western margin (not the Tropical Monsson type of climate)

Pair 2 is correct –Most favorable climate for Cactus is the desert climate.

Pair 3 is incorrect – Spruce grows naturally in **Siberian type climate or Cool temperate continental** climate.

167. Solution: (b)

Exp) Option b is the correct answer.

Deserts are formed due to various climatic and geographical factors, such as **cold ocean currents, rain shadow effects, continentality, and high-pressure zones**. The presence of cold ocean currents reduces evaporation and condensation, limiting rainfall, while mountains can block moist winds, creating dry conditions on the leeward side. Some deserts also form due to their distance from moisture sources (continentality).

Row 1 is correct. The **Kalahari Desert is** located inland and experiences dry conditions primarily due to the **rain shadow effect** of the Drakensberg Mountains and its location within the subtropical high-pressure belt.

Row 2 is correct. The **Atacama Desert**, one of the driest places on Earth, is influenced by the **Peruvian (Humboldt) cold current**, which cools the air and limits cloud formation. Additionally, the **Andes Mountains create a rain shadow effect**, preventing moist winds from the Amazon Basin from reaching the Atacama, intensifying its aridity.

Row 3 is incorrect. The **Patagonian Desert is not in Central Asia but in South America**, covering parts of Argentina and Chile. It is primarily formed due to the **rain shadow effect** of the Andes Mountains, which block moist Pacific winds from reaching the region. While **continentality (distance from moisture sources) plays a minor role**, the **rain shadow effect is the primary reason** for its formation.

168. Solution: (c)

Exp) Option c is the correct answer

Mediterranean agriculture is not exclusive to the Mediterranean region but actually reflects a set of practices undertaken in the Mediterranean and climates similar to it. Under the most common climate classification system.

Statement 1 is correct: Mediterranean agriculture is characterized by the cultivation of crops adapted to hot, dry summers and mild, wet winters. In general, there is almost no precipitation or cloud cover during the summer months. Winter and spring months are when Mediterranean climate areas receive the vast majority of rain for the entire year.

Statement 2 is correct: The climate of Central Chile is of temperate Mediterranean type, with the amount of rainfall increasing considerably and progressively from north to south. **Similarly, the Western Cape province of South Africa has a Mediterranean climate with warm** to hot, dry, sunny summer weather and mild, rainy conditions in winter. Both places thus practice Mediterranean agriculture.

169. Solution: (d)

Exp) Option d is the correct answer.

Xerophytes are a group of plants that have **evolved adaptations to survive in deserts where dry or arid environments exist with little available water.** They are able to thrive in these harsh conditions due to a variety of physical and physiological adaptations, **such as water-storing stems, deep roots to access underground water sources, and specialized leaf structures** that reduce water loss through transpiration. Xerophytes are most likely to be found in desert environments, where rainfall is low and temperatures can be extreme. Examples of **desert xerophytes include cacti, agaves, and yuccas**. Some xerophytes also live

in other types of dry environments, such as grasslands or rocky outcrops. The reason xerophytes are predominant in these environments is due to their adaptations to cope with the lack of water.

170. Solution: (d)

Exp) Option d is the correct answer.

Temperate Steppe Grassland are found in the parts of Eurasia and North America. It experiences hot summers and cold winters with the rainfall of 500-900 mm. It has thin flocculated soil, rich in bases. With respect to flora and fauna, it has **grasses and occasional trees** such as cottonwoods, oaks and willows; gazelles, zebras, rhinoceros, wild horses, lions, varieties of birds, worms, snakes etc., are common animals.

Important Tips

The **Tropical Savannahs** are practically treeless and the grasses are taller as compared to temperate steppe. Large regions of tropical savanna extend through the nations of Botswana, Namibia, and Kenya in Africa, southern Brazil, India, and Australia.

In **cold dessert**, few plants survive. The greatest inhibiting factor is the region's deficiency in heat. There are no trees in the tundra. Such an environment can support only the lowest form of vegetation, mosses, lichens and sedges.

The **taiga**, which is also known as the boreal forest region, occupies about 17 percent of Earth's land surface area in a circumpolar belt of the far Northern Hemisphere. The taiga is characterized predominantly by a limited number of conifer species of pine. Plants and animals in the taiga are adapted to short growing seasons of long days that vary from cool to warm.

171. Solution: (c)

Exp) Option c is the correct answer.

Tundra forests are a biome **characterized by their cold and harsh climate, dominated by long, cold winters** and short, cool summers. They **are found in the northern hemisphere, in regions such as Canada, Russia, and Scandinavia**. The dominant tree species in **tundra forests are evergreens, such as spruce, fir, and pine**. These trees are adapted to the **cold climate by having narrow needles, which help them conserve water**, and a conical shape, which allows them to shed snow easily. The understory of tundra forests is typically composed of shrubs, mosses, and lichens. Tundra forests are an important habitat for a wide range of wildlife. Mammals such as moose, reindeer, wolves, and bears are commonly found in these forests, as are a variety of bird species, including owls, woodpeckers, and grouse. Many of these animals rely on the forests for food and shelter, and some, such as the lynx and the snowshoe hare, have evolved specialized adaptations to survive in the harsh winter conditions.

172. Solution: (a)

Exp) Option a is the correct answer.

The equatorial regions support a tropical rain forest due to high temperature and abundant rainfall, which is characterized by a great variety of vegetation including evergreen trees, smaller palm trees, climbing plants, ferns, orchids, and Lalang.

Statement 1 is correct: Epiphyte, also called air plant, any plant that grows upon another plant or object merely for physical support. Lianas are plants with long, flexible, climbing stems that are rooted in the ground, and **usually have long dangling branches**. Equatorial rainforests are characterized by the presence of Epiphytes and Lianas. One of the main reasons for such adaptation is to get access to the physical prerequisites like Sunlight.

Statement 2 is correct: In the Amazon basin, Tropical Rain Forests are so dense and so complete in their vegetational extravagance that a special term ***"Selvas"*** is used to denote them.

Statement 3 is incorrect: Tropical evergreen forests are difficult to exploit for commercial purposes because these forests are dense, and many plants and climbers are tangled with each other. Secondly, the lack of means of transport deep into the forests has made these trees difficult to be used commercially.

173. Solution: (a)

Exp) option a is the correct answer.

Taiga, the term includes all cool, northern coniferous forests, including the so-called boreal forests of North America and Europe

Statement 1 is correct: The boreal forest (or "taiga") is the **world's largest land biome in terms of area**. The boreal ecozone principally spans 8 countries: Canada, China, Finland, Japan, Norway, Russia, Sweden and the United States.

Statement 2 is correct: The **Taiga types of forest are only found in the northern hemisphere** where the continents within the high latitudes have a broad east-west spread. The narrowness of the southern continents in the high latitudes is the main reason for absence of taiga forests in southern hemisphere.

The strong oceanic influence also reduces the severity of the winter in the southern hemisphere.

Statement 3 is incorrect: It is mainly made up of coniferous forest and **trees such as larches, spruces, birches, aspens, firs, and pines.** The conifers, which require little moisture are best suited to this type of sub-Arctic climate. Thus, there is no absence of trees, hence incorrect.

174. Solution: (c)

Exp) Option c is the correct answer.

Tropical Moist Deciduous forests, characterized by **moderate rainfall and distinct wet and dry seasons**, are vital ecosystems found across various regions in India.

Statement a is correct: Tropical Moist Deciduous forests are found in the areas with moderate **rainfall between 100-200 cm. per annum**. The **mean annual temperature** in these

forests ranges **around 24 - 27 degrees Celsius**. The **average annual relative humidity** in these forests is **between 60-75%.**

Statement b is correct: Tropical Moist Deciduous forests are widely distributed covering both in southern and northern states including Tamil Nadu, Arunachal Pradesh, Assam, Meghalaya, Mizoram, Bihar, West Bengal, Odisha, and Uttarakhand.

Statement c is incorrect: Tropical Moist Deciduous forests **generally shed their leaves during 6-8 weeks during the spring and early summer season.** During this period, **sufficient moisture for leaves is not available**. The sub-soil water is not enough for the trees to retain their leaves throughout the year. These forests give burnt-up appearance during April and May. The new leaves again grow during the rainy season.

Statement d is correct: Tropical Moist Deciduous forests have usually 2 to 3 distinct layers with a much lower number of species as compared with the tropical evergreen and semi evergreen forests. The canopy trees are light demanding, middle ones are shade tolerant species of shrubs and young trees, and on ground floor are present herbs and saplings. Climbers are abundant.

175. Solution: (b)

Exp) Option b is the correct answer.

Savannah vegetation, characterized by its unique blend of tall grasses and scattered trees, thrives in the semi-arid to sub-humid climates of tropical and subtropical regions. This dynamic ecosystem, often referred to as "bushveld" or "parkland," showcases a remarkable adaptation of flora to seasonal variations in rainfall and temperature.

Statement 1 is incorrect: Trees in the Savannah region are deciduous and shed their leaves during the cool, dry season to prevent excessive water loss through transpiration. This adaptation helps trees survive in the arid conditions of the Savannah by minimizing water loss during periods of limited rainfall.

Statement 2 is correct: Grasses in Savannah regions grow in compact tufts often develop deep root systems as an adaptation to access water from deeper soil layers, especially during dry periods when surface water may be scarce. These deep root systems help grasses survive and thrive in environments with irregular rainfall patterns and prolonged dry seasons characteristic of Savannah regions.

Statement 3 is correct: In the Savannah region, where water is often scarce, plants have evolved leaves that are small or needle-shaped to minimize surface area exposed to the sun and reduce water loss through transpiration. Large, broad leaves would increase water loss and make the plant more susceptible to drought stress.

176. Solution: (d)

Exp) option d is the correct answer.

Teak (Tectona grandis) is a deciduous tree that can grow up to 30-30 meters tall, and has large, oval shaped leaves. It is one of the world's premier hardwood timbers, famous for its mellow colour, fine grain and durability. It grows well in alluvial soils, fairly moist, warm, tropical climate with pH ranges from 6.5 to 7.5.

Statement 1 is incorrect: Teak (Tectona grandis) is native only to the tropical forests of South and Southeast Asia. Its natural range includes countries like India, Myanmar, Thailand, Laos, Cambodia, and Indonesia. Due to its excellent qualities such as durability, resistance to decay, and attractive appearance, **teak has been introduced to various parts of the world,** including Africa (mainly tropical Africa), South America, Caribbean islands, and is some pacific islands too.

Statement 2 is incorrect: As per Global Forest resources assessment report (2020), published by Food and Agriculture organisation, **Myanmar (not India) is the largest producer of teak.**

Statement 3 is incorrect: Teak is not considered a minor forest produce (MFP) under the Forest Rights Act (FRA) 2006. MFP is defined under the FRA as all non-timber forest produce of plant origin, including bamboo, canes, mushrooms, honey, wax, lac, tendu leaves, medicinal plants, and other forest products. Trees are not covered by the provisions of the FRA that relate to the rights of forest-dwelling communities to access and use MFPs. For example, forest-dwelling communities do not have the right to collect and sell teak wood under the FRA.

177. Solution: (a)

Exp) option a is the correct answer.

The **Coniferous Forests, also known as Taiga forests**, are found in cold regions with long, harsh winters and short, mild summers. They are mainly located in the Northern Hemisphere, covering parts of Canada, Russia, Scandinavia, and Alaska.

Statement I is correct. Coniferous forests are home to **trees like pine, spruce, and fir**, which have **narrow, pointed needle-like leaves** instead of broad leaves. These trees reproduce using **cones rather than flowers**, which is why they are classified as conifers.

Statement II is correct. The **shape and structure of needle-like leaves** play a crucial role in helping coniferous trees survive extreme cold. These leaves are **narrow and covered with a thick, waxy coating**, which helps **reduce water loss and prevent freezing during harsh winters**. Since water is often **scarce in cold regions due to frozen soil, trees need to retain as much moisture as possible.**

Statement II explains Statement I. In cold regions, **water is often unavailable because it remains frozen for long periods.** If trees had broad leaves, **they would lose too much moisture through evaporation**, making survival difficult. **Needle-like leaves are narrow and have a waxy coating, which prevents excessive water loss and protects them from freezing.**

178. Solution: (c)

Exp) Option c is the correct answer.

The **steppe climate, also known as Temperate Continental Climate** is a semi-arid climate found primarily in the interior regions of continents (particularly in Northern Hemisphere) of the **temperate areas.**

It is characterized by low rainfall, continentality, and frequent droughts. Due to these harsh conditions, trees struggle to grow, and the landscape is dominated by grasses and shrubs.

The main reasons for the scarcity of trees in steppe regions include **scanty rainfall, severe winters, frequent droughts, and the lack of maritime influence.**

Option 1 is correct: In steppe regions, rainfall is limited (usually between 25–75 cm annually). This inadequate moisture is insufficient to support the growth of large trees, resulting in the dominance of grasslands and shrubs. The **lack of consistent rainfall** is **one of the most critical factors for the scarcity of trees.**

Option 2 is correct: Many steppe regions, particularly those in the Northern Hemisphere, **experience extremely cold winters** with freezing temperatures. These conditions make it **difficult for trees to survive,** as they require a more stable climate with moderate winters.

Option 3 is correct: Steppe climates often face **prolonged droughts and dry spells,** which prevent tree seedlings from establishing roots. Even if trees do start to grow, recurring droughts cause water shortages, leading to their withering.

These **drought conditions create water stress,** further **limiting the growth of trees** and supporting only drought-resistant vegetation like grasses. As grasses can survive such conditions by going dormant during dry periods.

Option 4 is correct: Steppes, particularly those in Northern Hemispheres, are **located in interior regions far from oceans,** and hence experience **continental type of climate.** This lack of maritime influence leads to **low humidity and extreme annual temperature variations** (with hot summers and cold winters), both of which make it **difficult for the growth and survival of trees.**

Option 5 is incorrect: Steppe regions are **primarily influenced by westerly winds, not easterly winds.** Easterly winds (e.g., trade winds) are more dominant in tropical regions and do not significantly impact steppe climates. While winds in steppe regions can contribute to dryness, they are not the main reason for tree scarcity

179. Solution: (c)

Exp) Option c is the correct answer.

Grasslands are vast open landscapes dominated by grasses and have very few trees. They form in regions where rainfall is enough to support grass growth but not dense forests. Grasslands are mainly classified into two types based on climate:

1. Temperate Grasslands (Steppe) – Found in temperate regions.
2. Tropical Grasslands (Savanna) – Located near the equator in tropical areas.

Temperate Grasslands:

Temperate grasslands are found in regions with moderate rainfall (25-75 cm annually), which is enough to sustain grasses but not forests. These areas have hot summers and cold winters, making them different from tropical savannas. The fertile soil in these grasslands makes them ideal for farming and livestock grazing.

Some well-known temperate grasslands include the **Prairies (North America), Pampas (South America), Velds (South Africa), Steppes (Eurasia), Canterbury Plains (New Zealand) and Downs (Australia).**

Option 1 is correct: Pustaz (Hungary, Central Europe) – Temperate Grassland

1. Found in Hungary and surrounding areas in Central Europe.
2. These are classified as temperate grasslands.
3. Primarily used for agriculture, particularly wheat cultivation.

Option 2 is correct: Pampas (Argentina, Uruguay, Brazil) – Temperate Grassland

1. Found in South America, mainly in Argentina, Uruguay, and southern Brazil.
2. These are also temperate grasslands.
3. It is known for its fertile soils, making it ideal for agriculture, especially for growing crops like wheat and corn. It's a major region for cattle ranching as well.

Option 3 is incorrect: Llanos (Venezuela, Colombia) – Tropical Grassland

1. Located in northern South America, mainly in Venezuela and Colombia.
2. These are **tropical grasslands, not temperate.**
3. The Llanos are known for their rich biodiversity. They are mainly used for cattle grazing and seasonal agriculture.

Option 4 is correct: Velds (South Africa) – Temperate Grassland

1. Found in South Africa, Lesotho, Zimbabwe and surrounding regions.
2. These are temperate grasslands.
3. Supports pastoral farming, with sheep and cattle grazing being prominent.

Option 5 is correct: Canterbury (New Zealand) – Temperate Grassland

1. Situated in the Canterbury Plains of New Zealand, on the South Island.
2. These are temperate grasslands.
3. Known mainly for sheep grazing and dairy farming.

180. Solution: (c)

Exp) Option c is the correct answer.

Equatorial vegetation is characterized by dense, evergreen forests found in regions near the equator, such as the Amazon Basin, Congo Basin, and parts of Southeast Asia.

1. **Hardwood Tree Species** – These forests contain a **wide variety of evergreen trees** that produce **valuable tropical hardwoods** like **mahogany, ebony, greenheart, cabinet woods, and dyewoods**, which are used for furniture and construction.
2. **Dense Undergrowth** – The forest floor supports **smaller palm trees, ferns, and shrubs**, along with **climbing plants like lianas (rattan)**, which can grow hundreds of feet long. **Grasses like Lalang** thrive in these conditions, adapting to the humid environment.
3. **Epiphytes and Parasitic Plants** – **Epiphytes, such as orchids, mosses, and ferns, grow on tree branches** to access sunlight without harming the host tree. **Parasitic plants** extract nutrients from host trees, further enriching the biodiversity of the rainforest.

Important Tips

Temperate Deciduous Vegetation is found in regions with distinct seasons like Europe and North America, this **vegetation includes trees such as oak and maple that shed leaves in autumn.** The **undergrowth is moderate**, consisting of shrubs and ferns, as sunlight can penetrate the canopy.

Mediterranean Vegetation is found in areas with hot, dry summers and mild, wet winters, such as the Mediterranean region and California, this **vegetation includes drought-resistant plants like olive trees and shrubs.** Plants have adaptations like deep roots and thick bark to survive dry conditions and frequent wildfires.

Taiga Vegetation is found in cold regions like Canada and Russia. **It is dominated by coniferous trees** such as pine and spruce, which have needle-like leaves to minimize water loss.

181. Solution: (b)

Exp) Option b is the correct answer.

Temperate grasslands are vast regions characterized by grasses and herbaceous plants, typically found in areas with moderate climates and limited rainfall. These grasslands are spread across different continents, each with distinct local names based on their geographical locations.

Pair 1 is incorrectly matched: The Pustaz grasslands are located in **Hungary**, not Kenya. Kenya is known for its savanna grasslands. The Puszta is a temperate grassland characterized by flat or gently rolling plains. It is part of the Great Hungarian Plain and is known for its rich cultural heritage, including traditional Hungarian pastoralism.

Pair 2 is correctly matched: The **Downs grasslands are located in Australia**, particularly in the eastern part of the country. These grasslands are used extensively for agriculture, including wheat farming and livestock grazing.

Pair 3 is correctly matched: The Velds **are temperate grasslands located on the high plateau of South Africa.** They are divided into different types based on altitude and rainfall, such as the Highveld (higher altitude, cooler) and Lowveld (lower altitude, warmer).

Pair 4 is incorrectly matched: The **Prairies are vast temperate grasslands that stretch across the central part of North America.** They are divided into three types: tallgrass prairie (east), mixed-grass prairie (central), and shortgrass prairie (west). The climate is continental, with hot summers and cold winters, and moderate rainfall.

GENERAL GEOGRAPHY

INDIAN PHYSICAL ENVIRONMENT

5.1. Location and Physiography

1. Consider the following pairs:

Region	Description
1. Khadar	Newer and younger deposits of the flood plains
2. Bhangar	Contains Kankar soil with calcareous deposits
3. Bhabar:	Smaller streams disappear underground here

Which of the pairs given above are correctly matched?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

2. Consider the following statements about the Himalayas:
1. Himalayas are the youngest fold mountains of India.
2. Marmolada glacier is one of the largest glaciers located in the Himalayas.
3. The longitudinal valleys present in the Himalayan regions are known as Duars.
4. The crustal thickness of the Himalayan range generally increases from the Indo Gangetic plains towards the Greater Himalayas.

Which of the statements given above are correct?
(a) 1 and 4 only
(b) 1 and 2 only
(c) 1, 2 and 3 only
(d) 3 and 4 only

3. Arrange the following Hills of the North-East India in the correct sequence of their location from North to South.
1. Mikir Hills
2. Mishmi Hills
3. Dafla Hills
4. Lushai Hills

Which of the options given below is correct?
(a) 1 – 2 – 3 – 4
(b) 4 - 2 – 3 – 1
(c) 2 - 3 – 1 – 4
(d) 3 – 2 – 4 - 1

4. Which of the following pairs is/are correctly matched?

Types of Thrust	Located Between
1. Main Frontal Thrust (MFT)	Between Shiwalik Himalayas and Northern Plain
2. Main Central Thrust (MCT)	Between the Lesser Himalayas and the Shiwalik Himalayas
3. Main Boundary Thrust (MBT)	Between the Greater Himalayas and Lesser Himalayas

Select the correct answer using the code given below:
(a) 1 only
(b) 2 only
(c) 3 only
(d) 1 and 3 only

5. Consider the following statements regarding the various rocks systems of India:
1. Archean rocks are only found in the Aravalli Mountains.
2. Papaghani series is related to the Cuddapah system of rocks.
3. Vindhyan rocks are largely devoid of metalliferous minerals.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 and 3 only
(c) 2 only
(d) 1, 2 and 3

6. With reference to the Western Himalayas, consider the following statements:
1. All the three ranges (Greater, Lesser and Shiwalik) of Himalayas are found in this region.
2. The Shiwalik Himalayas is locally known as Nagtibha in Uttarakhand.
3. Bhotiya is a tribe which lives in the upper reaches of Himalayas.

4. Marg are the summer grasslands found on the slopes of Lesser Himalayas.

Which of the statements given above are correct?
(a) 2 and 3 only
(b) 1, 3 and 4 only
(c) 2, 3, and 4 only
(d) 1, 2, 3 and 4

7. Which of the following statements best describes the difference between the Eastern Ghats and the Western Ghats?

1. Eastern Ghats are comparatively more continuous than Western Ghats.
2. Eastern Ghats have a much higher level of biological diversity than Western Ghats.
3. Eastern Ghats are relatively older geological feature than the Western Ghats.

Select the correct answer using the code given below:
(a) 1 only
(b) 3 only
(c) 1 and 2 only
(d) 2 and 3 only

8. Consider the following pairs regarding different Mountain Passes:

Name of Passes	Connects
1. Aghil Pass	Ladakh with China
2. Pensi La	Kashmir Valley with Kargil.
3. Mangsha Dhura	Himachal with Ladakh.
4. Bomdila pass	Arunachal Pradesh with Myanmar.

Which of the above pairs are correctly matched?
(a) 1 and 2 only
(b) 3 and 4 only
(c) 1, 2 and 4 only
(d) 1, 2 and 3 only

9. Which of the following hills/ranges are the part of the Satpura Range?

1. Mahadeo hill
2. Rajpipla hill
3. Maikala range
4. Rajmahal hill

Select the correct answer using the code given below:
(a) 1 and 4 only
(b) 2, 3 and 4 only
(c) 1, 2 and 3 only
(d) 1 and 3 only

10. Duncan Passage is a strait in the Bay of Bengal that separates which of the following two Islands?
(a) North Andaman and Middle Andaman
(b) Middle Andaman and Southern Andaman
(c) Southern Andaman and Little Andaman
(d) Little Andaman and Car Nicobar

11. Which of the following statements regarding the process of formation of Aravalli's is correct?
(a) It is formed as a result of faulting in the ground surface due to endogenetic forces.
(b) It is formed because of gradual sedimentation bordered by two rigid masses.
(c) It is formed by magnetic intrusions and unwarping of the crustal surface.
(d) It is formed due to folding of crustal rocks by compression due to endogenetic forces.

12. Which of the following are located on/ found within Lakshadweep Islands?

1. Barren Island
2. Narcondam Island
3. Baratang Islands
4. Dhinodhar Hills

Select the correct answer using the code given below:
(a) 1, 2 and 3 only
(b) 2 and 3 only
(c) 4 only
(d) None of these

13. In the context of Indian physiography, consider the following statements about Karewas:

1. Karewas are fertile alluvial soils found in the Kashmir valley.
2. These are important for the cultivation of almonds, walnuts and apples.
3. Karewas are formed by unconsolidated lacustrine deposits.

Which of the statements given above is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

14. Which of the following statements best describe the term 'Rohi'?

(a) The fertile flood plains located near the western slopes of Aravali.
(b) A marshland area recently recognised as the Ramsar site.
(c) A hilly tract famous for Gucchi cultivation located in the Khasi hills.
(d) Dry wasteland located on the western side of the cold deserts of Ladakh.

15. With reference to coastal plains of India, consider the following statements:

1. The Eastern Coastal Plain is an example of Emergent Coast.
2. The rivers flowing through Western Coastal Plains do not usually form deltas as slope of rivers is very steep.
3. Kayals are found along the Western Coastal Plains.
4. No estuary is found along the eastern coastal plains.

Which of the statements given above is/are correct?

(a) 1 and 4 only
(b) 2 and 3 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

16. With reference to the various passes in the different mountain ranges of India, consider the following pairs:

Pass	Importance
1. Lipu Lekh	Provides passage for pilgrims to Kailash Manasarovar
2. Rohtang Pass	Connects Kashmir and Himachal Pradesh
3. Nathu La	Used as a trade route between India and China
4. Khardung La	Connects Srinagar to Jammu region

Which of the pairs given above is/ are correct?

(a) 1 and 3 only
(b) 2 and 4 only
(c) 1 and 4 only
(d) 2 and 3 only

17. "It is a steep shoreline formed by fluvial deposition action in the Punjab-Haryana region. It is formed just beyond the region of fresh alluvial deposition brought in by the annual flooding of the rivers. It is often more than 3 metres in height. It has been subjected to heavy gully erosion by the streams along which they are formed."

Which physiographic subdivision of India is being described in the paragraph above?

(a) Bhur
(b) Cho
(c) Reh
(d) Dhaya

18. With reference to the geological history of India, consider the following rock systems:

1. Dharwar
2. Cuddapah
3. Archaean
4. Vindhyan

Which of the options given below shows the correct chronological order of formation of these rock systems from oldest to newest?

(a) 1-2-4-3
(b) 3-2-1-4
(c) 1-4-3-2
(d) 3-1-2-4

19. With reference to the various divisions of the Western Coastal Plains and their characteristic features, consider the following pairs:

Region	Feature
1. Konkan	A number of Natural Harbours are located.
2. Kathiawa	It is of Volcanic origin
3. Malabar	Not suitable for agriculture
4. Karnataka plains	Broadest part of the Western Coastal Plains

How many pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

20. With reference to the Satpura Mountain Range, consider the following statements:

1. It is an example of Young Fold Mountains.
2. The height of this mountain range is still increasing, at a pace even greater than Himalayas.
3. It is one of the richest sources of coal and manganese deposits in India.

Which of the statements given above is/ are correct?

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) None of the above

21. Arrange the following mountain peaks of India in correct order of their location from East to West:

1. Kanchenjunga
2. Kamet
3. Nokrek
4. Nun-Kun

Select the correct answer using the code given below:

(a) 1-2-3-4
(b) 3-2-1-4
(c) 3-1-2-4
(d) 1-3-4-2

22. In context to India's physical geography, which of the following statements correctly explains the term 'Dhrian'?

(a) Region of marshy and swampy land along the Himalayan foothills
(b) Elevated Plateau region along the Ganga River
(c) Area of saline deposits in the Northern Plains
(d) Shifting sand dunes in western Rajasthan

23. With reference to Rift Valleys, consider the following statements:

1. It is a lowland region that forms where the Earth's tectonic plates move apart.
2. Many of the Earth's rift valleys are found on the Ocean floors.
3. Narmada is the only river in India that flows through a rift valley.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 only
(d) 1, 2 and 3

24. "These are the alluvial floodplains in the foothills of the Eastern Himalayas in the region of Eastern and North-eastern India. The region has Teesta River on the west and Sankosh river on the east. The region forms the gateway to Bhutan from India"

Which of the following region is mentioned in the above paragraph?

(a) Bugyals
(b) Marg
(c) Duars
(d) Payar

25. With reference to the Andaman & Nicobar Islands group, consider the following statements:

1. It is considered an extension of the Arakan–Yoma Mountains of Myanmar.
2. Unlike the Lakshadweep Islands, Andaman & Nicobar Islands are of coral origin.
3. The island group is marked by the presence of the Mangrove forests.
4. The Ritchie's Archipelago is a part of this Island group.

Which of the statements given above are correct?

(a) 1 and 3 only
(b) 1 and 4 only
(c) 2, 3 and 4 only
(d) 1, 3 and 4 only

26. With reference to India's position within different heat Zones of Earth, consider the following statements:

Assertion (A): Only around half of the territory of India lies in the Tropical zone, yet India has a Tropical climate.

Reason (R): The Himalayas act as a climatic barrier for India.

Which of the options given below is correct?

(a) Both A and R are correct and R is the correct explanation for A.
(b) Both A and R are correct but R is not the correct explanation for A.
(c) A is incorrect but R is correct.
(d) Neither A nor R is correct.

27. Consider the following statements regarding Arunachal Himalayas:

1. Kangto mountain peak lies in Arunachal Himalayas.
2. Prominent tribal communities such as the Mishmi and Abor inhabit Arunachal Himalayas.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

28. Consider the following States:

1. Chhattisgarh
2. Karnataka
3. Andhra Pradesh
4. Madhya Pradesh
5. Maharashtra

How many of the above given States share the boundary with the State of Telangana?
(a) Only two
(b) Only three
(c) Only four
(d) All five

29. Which of the following statements is *incorrect* with reference to Malda fault?
(a) The northeastern states of India are separated by the Malda fault from the Chota Nagpur Plateau.
(b) The down-thrusting of the Malda gap area during the mid-Pleistocene period, diverted the Brahmaputra River system to flow towards the Bay of Bengal.
(c) Malda gap was filled by sediment deposits of the Ganga and its tributaries.
(d) It is a major fault along the southern boundary of the Shillong plateau.

30. Consider the following statements:

Statement I: 82°30' East longitude has been selected as the Standard Meridian of India.

Statement II: The 82°30' East longitude passes approximately from the middle of the longitudinal extent of India.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect, but Statement-II is correct.

31. Consider the following Indian states:
1. Sikkim
2. Mizoram
3. Assam
4. Meghalaya
5. Nagaland

How many of the above-mentioned states of India share a land border with Bangladesh?
(a) Only two
(b) Only three
(c) Only four
(d) All five

32. This region is a narrow belt of coarse alluvial deposits found at the foothills of the Himalayas. It is rocky and porous, causing rivers from the mountains to disappear underground due to the porous nature of the terrain. It is relatively less fertile compared to the adjacent plains.

The above paragraph describes which one of the following regions of India?
(a) Bhangar
(b) Tarai
(c) Khadar
(d) Bhabar

33. With reference to Western Ghats of India, consider the following statements:
1. The Western Ghats' average elevation is lesser compared to the average elevation of Eastern Ghats.
2. The highest peak of the Western Ghats is Kalsubai in Maharashtra.
3. Thamirabarani and Tungabhadra River originate in the Western Ghats.

Which of the above given statements is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 3 only

34. With reference to Meghalaya plateau in India, consider the following statements:
1. The Meghalayan plateau is an extension of Indian Peninsular Plateau.
2. This plateau is rich in natural gas and crude oil.
3. This plateau has a highly eroded surface.

Which of the above given statements is/are correct?
(a) 1 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 3 only

35. Consider the following statements:
1. The western coastal plain of India is a submerging coastal plain, while the eastern coastal plain is an emergent coastal plain.
2. Unlike the western coastal plain of India, the eastern coastal plain of India has a significantly narrower continental shelf.
3. The western coastal plain of India is geographically more favorable for ports compared to the eastern coastal plain of India.
4. The western coastal plain of India lacks extensive river deltas as compared to the eastern coastal plain of India.

Which of the above given statements are correct?
(a) 1, 2 and 3 only
(b) 1 and 2 only
(c) 1, 3 and 4 only
(d) 2, 3 and 4 only

36. With reference to Indian Geography, 'Ten-degree channel' separates-
(a) Kalpeni and Suheli Par Islands of Lakshadweep and Maliku Atoll (Minicoy Island).
(b) the Andaman and Nicobar Islands.
(c) the Minicoy Island and the Maldives.
(d) the island of Minicoy from the main Lakshadweep archipelago.

37. With reference to geological features of Eastern and western coasts of India, consider the following statements:

Statement-I: Compared to the western coasts, erosional activity dominates the Eastern coasts of India.

Statement-II: Most of the major rivers in India are east flowing rivers.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

38. With reference to Aravalli Mountain ranges, consider the following statements:
1. It is one of the oldest block mountains in the world.
2. It is rich in mineral resources like Copper and Zinc.
3. Luni and Banas Rivers originate in the Aravalli mountains.
4. It acts as a barrier preventing the extension of desert from western to eastern parts of Rajasthan.

Which of the above given statements are correct?
(a) 1, 2 and 3 only
(b) 1 and 2 only
(c) 1, 3 and 4 only
(d) 2, 3 and 4 only

39. Consider the following statements regarding the Peninsular plateau of India:
1. The Peninsular plateau contains more than 95% of India's Gondwana coal deposits.
2. The black soil and warm climate found in the Peninsular plateau make it conducive for cotton cultivation.
3. All the rivers originating from the Peninsular plateau drain into the Bay of Bengal.
4. While the plateau is rich in iron deposits, it lacks strategic reserves such as Uranium.

Which of the above given statements are correct?
(a) 1, 2 and 3 only
(b) 1 and 2 only
(c) 1, 3 and 4 only
(d) 2, 3 and 4 only

40. With reference to Eastern Ghats, consider the following statements:
1. Jhindagada peak, the highest peak of Eastern ghats is located in the State of Odisha.
2. Brahmani and Subarnarekha rivers originate from the Eastern ghats.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

41. With reference to the Deccan traps, consider the following statements:
1. The deccan traps were created during the northward migration of Indian plate.
2. Deccan traps are confined solely to the States of Maharashtra and Gujarat.
3. Ferruginous lateritic ores found in several areas of deccan traps comprise higher iron content than any other iron ores.

Which of the above given statements is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 3 only
(d) None of the above

42. Consider the following hills of Northeastern region of India:
1. Mizo hills.
2. Mishmi hills.
3. Mikir hills.
4. Barail hills.

Arrange the above given hills in the South to North direction and select the correct answer using the code given below:

(a) 4-1-3-2
(b) 4-1-2-3
(c) 1-4-3-2
(d) 1-4-2-3

43. With reference to the geographical characteristics of the Eastern and Western Coast of India, consider the followings statements:

1. Unlike the emergent coasts found along the Eastern coast, the Western coasts exemplify submergent coasts.
2. The peninsular rivers flowing into the Eastern coasts typically form deltas, whereas those flowing into the Western coasts do not form significant deltas comparatively.
3. The natural suitability for port formation is higher along the Eastern coasts compared to the Western Coasts.

Which of the above given statements is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 only
(d) 2 and 3 only

44. With reference to Karewa landforms in India, consider the following statements:

1. They are formed by unconsolidated and semi-consolidated lacustrine deposits.
2. They are mainly found in Himachal Pradesh, Punjab and Uttarakhand.
3. They are generally devoid of fossils.

Which of the above given statements is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 only
(d) 2 and 3 only

45. The Main/Himalayan Frontal Thrust (MFT/HFT) separates which of the following?

(a) The Lesser Himalayas and the Shivalik Himalayas.
(b) The Greater Himalayas and Lesser Himalayas.
(c) The Shivalik Himalayas and the Indo-Gangetic plains.
(d) The Greater Himalayas and the Tibetan plateau.

46. Consider the following statements regarding the geographical aspects of the Lakshadweep archipelago:

1. In terms of area, it is the smallest among all the Union Territories in India.
2. Kavaratti, the capital of Lakshadweep, has the largest area among all the islands of the Lakshadweep archipelago.
3. Minicoy is the southernmost island of Lakshadweep.
4. The 10 degrees channel separates the Lakshadweep islands and Maldives.

Which of the above given statements are correct?

(a) 1 and 4 only
(b) 1 and 3 only
(c) 1 and 2 only
(d) 2 and 4 only

47. "India's largest saltwater lake is located in these coastal plains. The freshwater lakes Samang and Sur are also found here. It is also home to India's one of the richest mangrove regions. This region has fertile red and black soils"

Which of the following regions has been discussed in the above passage?

(a) Konkan Plain
(b) Malabar Plain
(c) Utkal Plain
(d) Andhra Plain

48. What is common to the places known as' Didwana', 'Pachpadra', and 'Khatu'?

All of them are-

(a) Salt lakes.
(b) Newly notified wetlands under the Ramsar Convention.
(c) Arid landscapes.
(d) Deciduous forests.

49. With reference to some local landforms found in India, consider the following pairs:

Landforms	Meaning
1. Kallar	Narrow, elongated and low-lying depressions
2. Dhrians	Shifting sand dunes
3. Bugyals	Summer grass lands in the higher reaches

How many of the above pairs are **incorrectly** matched?

(a) Only one
(b) Only two
(c) All three
(d) None

50. Consider the following glaciers:

1. Siachen Glacier
2. Hispar Glacier
3. Zemu Glacier
4. Gangotri Glacier

What is the correct order of the above glaciers as we travel from east to west?

(a) 2-3-4-1
(b) 3-4-1-2
(c) 3-2-4-1
(d) 2-4-1-3

51. Consider the following mountain ranges:

1. Karakoram
2. Zaskar
3. Pir Panjal
4. Ladakh

Which of the following options is correct regarding the arrangement of the above given mountain ranges from North to South?

(a) 1-4-2-3
(b) 1-2-4-3
(c) 2-1-4-3
(d) 1-2-3-4

52. The Potwar Plateau acts as a water divide between which of the following river systems?

(a) Indus and Ganga
(b) Indus and Brahmaputra
(c) Brahmaputra and Ganga
(d) Ganga and Narmada

53. In the context of India's physical geography which of the statements given above is correct?

(a) There is no peak with the elevation of more than 3000 meters in Western Ghats.
(b) In India the cold desert is found only in the Union Territory of Ladakh.
(c) Banni Grasslands are found in the state of Rajasthan.
(d) Loktak lake is the largest freshwater lake in India.

54. With reference to Kumaon Himalayas, consider the following statements:

1. They are bounded by the Sutlej River to the west and the Kali River to the east.
2. Its highest peak is Nanda Devi.
3. A trijunction pass that connects India with China (Tibet) and Nepal is located in this part of the Himalayas.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) 3 only
(d) 1, 2 and 3

55. With reference to the Siachen Glacier, consider the following statements:

1. It is located in the Karakoram Range of the Himalayas.
2. It is the longest glacier in the world outside of the Earth's polar regions.
3. The Nubra River originates from this glacier.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2, and 3

56. Consider the following:

1. The Himalayan rivers are still in their youthful stage and can be said to be rejuvenated in recent times.
2. There is frequent occurrence of seismic activity in the Himalayan region.
3. Some fossil formations found in the Shiwalik hills are also available in the Tibetan plateau.
4. Desiccation of lakes of Tibet.

Which of the above proves that the Himalayas are still rising?

(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 3 and 4 only
(d) 1, 2, 3 and 4

57. Consider the following statements regarding Pangong Tso (Lake), recently seen in news:

1. It is an endorheic lake.
2. It is the highest lake in India.
3. Being a saline lake, it remains ice-free completely through the year.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3
(c) 1 and 3
(d) 1 and 2

58. Consider the following information:

Mountain Pass	State/Union Territory where it is located	Significance
1. Khardung La	Arunachal Pradesh	Connects Tawang to Dirang
2. Rohtang	Himachal Pradesh	Connects Kullu valley to Lahaul and Spiti
3. Sela	Ladakh	Connects Leh to Nubra Valley

In how many of the above rows is the given information correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

59. A particular plateau in India has the following features:
1. This plateau forms a part of the Central Highlands which itself is part of the Peninsular Plateau.
2. The origin points of Damodar, North Koel, South Koel and Subarnarekha rivers lie on this plateau.
3. This region is considered as the Ruhr of India.

Which one among the following plateaus has all the above features?
(a) Malwa Plateau
(b) Maharashtra Plateau
(c) Marwar Plateau
(d) Chotanagpur Plateau

60. Consider the following mountain ranges:
1. The Aravallis
2. The Vindhyas
3. The Satpura

How many of the above are examples of block mountains in India?
(a) Only one
(b) Only two
(c) All three
(d) None

61. Consider the following statements about the Andaman and Nicobar group of islands of India:
1. The Duncan Passage separates the Andamans from the Nicobar group of islands.
2. All of the islands of this group are of coral origin.
3. Saddle Peak in the North Andaman is the highest peak of this group of islands.
4. Barren Island, the only active volcano in India, is located in the Nicobar Islands.

Which of the statements given above is/are correct?
(a) 1 and 4
(b) 1 and 3
(c) 2 and 4
(d) 3 only

62. Through which of the following state(s) in India, does both the tropic of cancer as well as the Indian Standard Meridian pass through?
1. Madhya Pradesh
2. Jharkhand
3. Chhattisgarh
4. West Bengal
5. Andhra Pradesh

Select the correct answer using the code given below:
(a) 3 only
(b) 1, 2, 3 and 4
(c) 1 and 3 only
(d) 2, 4 and 5

63. Which of the following factors supported the British decision to introduce tea plantations in the Darjeeling Himalayas?
1. The slopes of the mountains in this region are not steep, but are moderate.
2. The soil cover in this region is very thick, with a high content of organic matter.
3. This region is characterised by the presence of Shiwalik formations.

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

64. Arrange the following regions in India in descending order with reference to the average annual rainfall received by the region:
1. Jaintia Hills
2. Ladakh
3. Deccan Plateau
4. Cachar Valley

Select the correct answer using the code given below:
(a) 4-1-3-2
(b) 4-1-2-3
(c) 1-4-3-2
(d) 1-4-2-3

65. Consider the following statements regarding the Andaman & Nicobar Islands:
1. The Andaman and Nicobar Islands are separated by a water body which is called the Ten degree channel.
2. Barren Island, the only active volcano in India, is situated south west of Sri Vijaya Puram (erstwhile Port Blair).
3. The entire island group is built of coral deposits.

Which of the statements given above is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

66. With reference to the Western Ghats, consider the following statements:
1. Dodabetta is the highest peak of the Western Ghats.
2. The Western and Eastern Ghats meet each other at Nilgiri Hills.
3. Nagavali and Vamsadhara rivers originate in the Western Ghats.

Which of the statements given above is/are correct?
(a) 1, 2 and 3
(b) 2 and 3 only
(c) 1 and 3 only
(d) 2 only

67. Which one of the following statements is correct with reference to the Meghalayan Plateau?
1. It is an extension of the Indian Peninsular Plateau.
2. It is rich in mineral resources like coal and uranium.
3. Mishmi hills are part of the Meghalayan plateau.
4. Kopili River originates in the Meghalayan Plateau.

Which of the above given statements are correct?
(a) 1, 2 and 4 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1, 2, 3 and 4

68. If you climb the Himalayas from the foothills to higher altitudes, then what is the correct sequence in which you are likely to see the following types of forests naturally growing there?
1. Wet temperate forests
2. Pine forests
3. Deciduous forests
4. Temperate grasslands

Select the correct answer using the code given below:
(a) 4-3-2-1
(b) 3-4-1-2
(c) 1-3-4-2
(d) 3-1-2-4

69. Consider the following peaks of Himalayan mountains:
1. Kamet
2. Dhaulagiri
3. Annapurna
4. Nanda Devi

Arrange the above given peaks from east to west as per their location:
(a) 1-2-4-3
(b) 1-4-2-3
(c) 3-2-4-1
(d) 4-2-3-1

70. Consider the following statements:
1. Kangra Valley is a type of strike valley.
2. Kullu Valley is a type of transverse valley.
3. Narmada River flows in a rift valley.

Which of the statements given above is/are correct?
(a) 3 only
(b) 1 and 2 only
(c) 1, 2 and 3
(d) 2 and 3 only

71. Consider the following pairs regarding the mountain passes in India and the mountain ranges within which they are located:

Mountain Pass	Located in
1. Zoji La	Karakoram Range
2. Banihal	Ladakh Range
3. Fotu La	Zanskar Range
4. Khardung La	Pir Panjal Range

Which of the pairs given above is/are correctly matched?
(a) 3 only
(b) 1, 3 and 4
(c) 2 and 4
(d) 1, 2 and 3

72. Consider the following statements:

Statement I: The Thar desert in India during the south west monsoon receives very little rainfall.

Statement II: There are no large perennial rivers flowing through the Thar desert.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I
(c) Statement-I is correct but Statement-II is incorrect
(d) Statement-I is incorrect but Statement-II is correct

73. Consider the following statements:

1. The state of Uttar Pradesh shares boundaries with a maximum number of other states of India.
2. Bangladesh has the longest international land border with India.
3. Myanmar shares land borders with the maximum number of Indian States or Union Territories (UTs).
4. Among the Indian states, the state of Maharashtra has the longest coastline.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1, 2 and 3
(c) 1 and 4
(d) 2, 3 and 4

74. Lakes can be formed by various geo-climatic and anthropogenic processes. In this context consider the following pairs.

1. Vembanad lake	Lagoon
2. Wular lake	Tectonic Lake
3. Vynthala lake	Man made Lake

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

75. With reference to the islands of India, consider the following pairs:

Island	Location
1. Kiltan Island	Lakshadweep
2. Ghoramara Island	Gulf of Mannar
3. Pirotan Island	Gulf of Kutch
4. Baratang Island	Odisha coast

Which of the pairs given above is/are correctly matched?

(a) 1, 2 and 3 only
(b) 2 and 4 only
(c) 1 and 3 only
(d) 1, 2, 3 and 4

76. Consider the following pairs:

Hills	Region
1. Cardamom Hills	Coromandel Coast
2. Kaimur Hills	Konkan Coast
3. Mahadeo Hills	Central India
4. Mikir Hills	North-East India

Which of the above pairs are correctly matched?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 and 4 only
(d) 2 and 4 only

77. If you travel through the shola forests of western Ghats, you are likely to see which of the following features?

1. Epiphytes like Lichens
2. Ferns and bryophytes grown on trees
3. Red-coloured young leaves turning into different colours on maturity
4. Rolling grasslands

Select the correct answer using the code given below:

(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

78. Consider the following statements:

1. In India, the Himalayas are spread over five states only.
2. Western Ghats are spread over five states only.
3. Pulicat Lake is spread over two States only.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 3 only
(c) 2 and 3 only
(d) 1 and 3 only

79. With reference to the Sundarbans delta, consider the following statements:
1. Sundarbans delta is formed by the floodplain of Ganges, the Brahmaputra and Meghna River.
2. More than 50% of the Sundarbans delta is located in Bangladesh.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

80. With reference to the Himalayas, consider the following statements:
1. The Western Himalayas rise almost abruptly from the plains located at its foothills.
2. Higher peaks of Western Himalayas are found to be at greater distance from the plains.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 and 2

81. With reference to the physiographic features in the Himalayan region, consider the following statements:
1. River Indus flows between Zaskar ranges and Ladakh ranges.
2. K-2, the second highest peak in the world is located in the Ladakh Ranges.
3. Kailash Range is an extension of Trans-Himalayas.

Which of the statements given above is/are correct?
(a) 1 and 2 Only
(b) 2 and 3 Only
(c) 1 and 3 Only
(d) 1, 2 and 3

82. Consider the following statements:
1. Houses in Rajasthan have thick walls to neutralize the effects of extreme temperature in different seasons.
2. The houses in the Tarai region are constructed with sloping roofs as these places receive heavy rainfall.
3. The houses in Assam are built on stilts to conserve water during the rainy season.

Which of the above given statements is/are correct?
(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

5.2. Drainage System

83. Consider the following rivers and their respective location:

River	Location
1. Thamirabarani river	Andhra Pradesh and Telangana
2. Sukapaika River	Jammu and Kashmir
3. Bhogdoi River	Assam and Nagaland
4. Lukha River	Meghalaya

Which of the above-given pairs are correctly matched?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 4 only
(d) 3 and 4 only

84. Consider the following pairs about the river confluences and the rivers which meet at these points:

River Confluences	Rivers
1. Dev Prayag	Alaknanda and Pindar Ganga
2. Vishnu Prayag	Dhauli Ganga and Vishnu Ganga
3. Karna Prayag	Mandakini and Alaknanda
4. Rudra Prayag	Bhagirathi and Alaknanda

How many of the above pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) All four

85. This river originates in the Trimbak Plateau of Maharashtra. From its source, it flows eastwards and joined by a large number of tributaries namely Manjra, Penganga, Wardha, Wainganga, Indravati and Pranhita. It flows through Maharashtra, Andhra Pradesh, Telangana, Chhattisgarh and Odisha. It is the largest river system of the Peninsular India.

Which of the following rivers is described in the above paragraph?

(a) Mahanadi
(b) Godavari
(c) Krishna
(d) Kaveri

86. Most of the rivers originating from the Himalayas in Northern India flows towards east and nearly 77% of the drainage is oriented towards the Bay of Bengal. Which of the following is the most appropriate reason for this drainage system?

(a) The Indian plateau slopes towards eastern side due to upliftment of Delhi ridge.
(b) The perennial nature of river forces them to take longer course.
(c) The rivers have many tributaries creating eastward pressure.
(d) Coriolis force is high around Tropic of Cancer forcing most rivers to deflect rightward.

87. With reference to the Indian geography, which of the following statements best describes the term 'Chos'?

(a) The high-altitude alpine grasslands in Uttarakhand
(b) Longitudinal valleys which are formed due to the collision between Eurasian and the Indian plate.
(c) Shifting sand dunes in eastern part of Marusthali
(d) Seasonal streams that erode parts of Punjab-Haryana plain adjoining the Shiwalik hills.

88. Which of the following water bodies/ drainage systems has a Centripetal Drainage pattern in India?

(a) All Streams from Vindhyan range
(b) Loktak Lake Manipur
(c) Rivers originating from Amarkantak hills
(d) Rivers of Indo-Gangetic plains.

89. Which of the following options represents the usability (use) of rivers and river water?

1. Provision of various types of sediments and minerals
2. Provision of irrigation and drinking water facility
3. Enables hydroelectricity production
4. Provision of waterways navigation
5. Storage of carbon

Select the correct answer using the code given below:

(a) 1, 2, 3 and 4 only
(b) 2, 3 and 5 only
(c) 1, 2, 3 and 5 only
(d) 1, 2, 3, 4 and 5

90. Burhner, Banjar, Dudhi, Tawa, and Orsang rivers are tributaries of which of the following rivers?

(a) Krishna
(b) Godavari
(c) Tapi
(d) Narmada

91. Arrange the following eastward flowing rivers of India from North to South.

1. Brahmani
2. Subarnarekha
3. Penner
4. Baitarani
5. Vaigai

Select the correct answer using the code given below:

(a) 2-4-1-3-5
(b) 2-1-4-5-3
(c) 2-1-4-3-5
(d) 1-2-4-3-5

92. Consider the following statements about the Machchhu river:

1. It originates from Madla hills in the state of Gujarat.
2. It drains into the Gulf of Khambhat.
3. It flows through Morbi district of Gujarat, which is very famous for ceramic industry.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

93. Which of the following rivers are tributaries of the Brahmaputra River?

1. Kameng
2. Tista
3. Barak

ForumIAS

4. Subansiri
5. Manas

Select the correct answer using the code given below:
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 2, 4 and 5 only
(d) 1, 2, 3, 4 and 5

94. Which of the following rivers flowing through India, originate outside India?
1. Satluj
2. Brahmaputra
3. Indus
4. Yamuna
5. Gandak

Select the correct answer using the code given below:
(a) 1, 2 and 4 only
(b) 2, 3 and 4 only
(c) 1, 2, 3 and 5 only
(d) 1, 2, and 5 only

95. Consider the following statements regarding the river Sukapaika:
1. It originates in Andhra Pradesh.
2. Recently, National Green Tribunal (NGT) ordered to revive and rejuvenate the river Sukapaika.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

96. Which of the following statements are the correct reason for Narmada and Tapi rivers not forming deltas?
1. Both rivers follow a very steep gradient
2. Both rivers have strong flow of water.
3. Both rivers flow through rocky topography.
4. Both rivers have large numbers of tributaries.

Select the correct answer using the code given below.
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

97. With reference to the Indus River, consider the following statements:
1. The Indus originates from Rakshas Tal Lake of the Tibetan Plateau.
2. Shyok and Gilgit are the Right-Bank tributaries of the Indus.
3. The river cuts across the Pir-Panjal range to form a gorge near Kashmir Valley.

Which of the statements given above is/are correct?
(a) 1 and 3 only
(b) 2 only
(c) 2 and 3 only
(d) 1 and 2 only

98. With reference to Narmada River, consider the following statements:
1. It is the longest west flowing river of Peninsular India.
2. The famous Ajanta Caves are situated on the banks of this River.
3. Hiran and Orsang are major tributaries of this River.
4. Maheshwar Dam is one of the dams constructed on this river.

Which of the statements given above are correct?
(a) 1 and 3 only
(b) 2 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2 and 3 only

99. Which of the following are the east flowing Peninsular Rivers in India?
1. Sharavati River
2. Bharathapuzha River
3. Pennar River
4. Brahmani River

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 and 4 only
(d) 1 and 4 only

100. Which of the following statements are *incorrect* about the Luni River?
1. The river is saline throughout its course.
2. It drains into the Arabian Sea.
3. The river forms a deep river bed by easily eroding the sandy terrain of the desert.
4. Jojari is the only right-bank tributary of the Luni River.

Select the correct answer using the code given below.
(a) 1, 2 and 3 only
(b) 3 and 4 only
(c) 1, 2 and 4 only
(d) 1, 3 and 4 only

101. Which of the following rivers cut across the tropic of cancer?

1. Mahanadi
2. Narmada
3. Mahi
4. Son
5. Betwa

Select the correct option using the code given below:

(a) 1, 2 and 3 only
(b) 1, 3, 4 and 5 only
(c) 3, 4 and 5 only
(d) 1, 2, 4 and 5 only

102. Which one of the following is the primary reason behind the Cauvery River's ability to maintain a consistent water flow throughout the year with relatively less fluctuation, compared to other Peninsular rivers?

(a) The river has lesser check dams and reservoirs when compared to other peninsular rivers.
(b) The river has a relatively short course which reduces the loss of water through evaporation and infiltration.
(c) The river benefits from a more extensive network of perennial tributaries.
(d) The river receives rainfall from both the Southwest and Northeast monsoons.

103. Consider the following rivers:

1. Vamsadhara
2. Indravati
3. Pranahita
4. Pennar

How many of the above are tributaries of Godavari River?

(a) Only one
(b) Only two
(c) Only three
(d) All four

104. With reference to the Brahmaputra River System, consider the following statements:

1. The river originates from Rakshastal Lake situated near the Kailash range in Himalayas.
2. World's largest riverine island, Majuli is situated on the Brahmaputra River in the state of Assam.
3. Before entering into India, the Brahmaputra River is joined by the rivers Dibang and Lohit.

Which of the statements given above is/are correct?

(a) 2 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

105. With reference to wetlands in India and the rivers associated with them, consider the following pairs:

Wetlands	Rivers associated
1. Keoladeo	Chambal
2. Ropar	Beas
3. Wular	Jhelum
4. Chilika	Daya

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

106. The Godavari is considered the largest Peninsular River system, which originates near Western Ghats and drains into the Bay of Bengal. In this context consider the following States of India:

1. Maharashtra.
2. Madhya Pradesh.
3. Chhattisgarh.
4. Andhra Pradesh.
5. Telangana.

Across how many of the above States, the Godavari River basin is spread?

(a) Only two
(b) Only three
(c) Only four
(d) All five

107. Consider the following tributaries of the river Ganga:

1. Gandak
2. Ghagra
3. Kosi
4. Ramganga

How many of the above tributaries of river Ganga originate in India?

(a) Only one
(b) Only two
(c) Only three
(d) All four

108. Consider the following statements:

Statement I: Majority of Indian rivers discharge their waters in the Bay of Bengal.

Statement II: Bay of Bengal drainage basin receives significant rainfall from both South-West and North-East monsoons.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

109. With respect to Hydroelectric projects in India, consider the following pairs:

River	Hydroelectric Projects
1. Chenab	Dulhasti Project
2. Jhelum	Chamera Project
3. Sutlej	Nathpa Jhakri Project

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

110. Which one of the following best describes the concept of 'Peak Water'?

(a) It refers to the seasonal peak of water flows in a river or stream during monsoon.
(b) It refers to a situation in which the supply of fresh water is not replenished at the rate it is consumed.
(c) It is a method of maximizing water usage in agriculture through advanced irrigation techniques.
(d) It marks the sudden increase in rainfall in a certain month of a year.

111. With reference to Ken-Betwa River linking project, consider the following statements:

1. It aims to transfer surplus water from the Betwa river in Madhya Pradesh to the Ken River in Uttar Pradesh.
2. It is the first project under the National Perspective Plan for the interlinking of rivers in India.
3. The development of Daudhan Dam Complex on Ken River is associated with this project.

Which of the statements given above is/are correct?

(a) 2 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

112. The Zabo or Ruza system is practiced largely in Phek district of Nagaland. In this context, is the Zabo or Ruza system related to which of the following?

(a) A water management system that includes rectangular-shaped stepwells to collect the subterranean seepage of an upstream reservoir or a lake.
(b) An indigenous farming system which combines forest, horticulture, agriculture, fishery and animal husbandry with soil and water conservation on one hill.
(c) An ecosystem-based strategy that focuses on long-term soil conservation through a combination of biological control, and habitat manipulation.
(d) An innovative farming technique that involves the growing of plants without soil.

113. With reference to various Dams and the rivers on which they are located, consider the following pairs:

Dams	The river on which it is situated
1. Bhakra Nangal dam	Ravi river
2. Hirakud dam	Mahanadi river
3. Nagarjuna Sagar dam	Godavari river
4. Indira Sagar dam	Chambal river

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

114. Consider the following statements regarding the Jhelum River:

1. It originates from the Verinag' spring in the Kashmir Valley.
2. It passes through the Wular Lake in Jammu & Kashmir.
3. It is the largest tributary of the Indus River.
4. Nallah Lidder is a tributary of the Jhelum River.

Which of the above given statements is/are correct?
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 2 and 4 only
(d) 1, 2, 3 and 4

115. Consider the following rivers
1. Sabarmati
2. Mahi
3. Indus
4. Pennar
5. Vaigai

How many of the rivers given above flow into the Arabian Sea?
(a) Only two
(b) Only three
(c) Only four
(d) All five

116. The Harike wetland is situated at the confluence of which of the following rivers?
(a) Chenab and Ravi.
(b) Beas and Sutlej.
(c) Jhelum and Chenab.
(d) Sutlej and Ravi.

117. Consider the following pairs regarding the Waterfalls and the rivers associated with it:

Waterfall	River
1. Jog Waterfall	Kaveri river
2. Sivasamudram Waterfall	Sharvati river
3. Dhuandhar waterfall	Narmada river

How many of the above pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

118. Consider the following statements:

Statement-I: Unlike many other peninsular rivers, Narmada and Tapi neither form deltas nor estuaries.

Statement-II: Narmada and Tapi flow through the rift valleys.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement- I
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I
(c) Statement-I is correct but Statement-II is incorrect
(d) Statement-I is incorrect but Statement-II is correct

119. Consider the following States/Union Territories of India:
1. Maharashtra.
2. Puducherry.
3. Karnataka.
4. Andhra Pradesh.
5. Kerala
6. Tamil Nadu.

How many of the above States/Union Territories (UTs) form part of the Cauvery River basin?
(a) Only three
(b) Only four
(c) Only five
(d) All six

120. Which Indian river's delta is the site of the Bhitarkanika Wildlife Sanctuary, famous for its estuarine crocodiles?
(a) Chambal river
(b) Son river
(c) Damodar river
(d) Brahmani river

121. Consider the following rivers of India:
1. Wainganga
2. Vaigai
3. Subarnarekha
4. Penner

What is the correct order of the above rivers as one travels from north to south directions?
(a) 3-4-1-2
(b) 1-3-4-2
(c) 1-4-2-3
(d) 3-1-4-2

122. Consider the following information:

Multipurpose project	State/Union Territory	River
1. Rihand Dam	Jammu and Kashmir	Jhelum
2. Tehri dam	Uttarakhand	Bhagirathi and Bhilganga

3. Nagarjuna Sagar dam	Telangana	Krishna
4. Hirakud dam	Odisha	Mahanadi

In how many of the above rows is the given information correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

123. Sometimes seen in news, the Daudhan Dam and Lower Orr Dam are associated with linking of which of the following rivers?
(a) Par - Tapi - Narmada
(b) Godavari and Krishna
(c) Ken and Betwa
(d) Mahanadi and Godavari

124. "It is a major tributary of the river Ganga. It originates near Gurla Mandhata peak, south of Mansarovar. One of its important tributaries is the Sarda River".

Which one of the following rivers is being described in the above paragraph?
(a) Gomati River
(b) Kosi River
(c) Gandak River
(d) Ghaghara River

125. With reference to the Peninsular rivers joining the Yamuna from West to East, which one of the following sequences is correct?
(a) Chambal – Sind – Betwa – Ken
(b) Sind – Chambal – Betwa – Ken
(c) Chambal – Betwa – Sind – Ken
(d) Chambal – Sind – Ken – Betwa

126. Which one of the following rivers joins the Satluj River in India?
(a) Chenab
(b) Ravi
(c) Beas
(d) Jhelum

127. Consider the following pairs:

Cities	Located on banks of
1. Bengaluru	Krishna
2. Surat	Tapi
3. Hyderabad	Godavari
4. Jodhpur	Banas

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

128. With reference to the Teesta River, consider the following statements:
1. It originates from the eastern Himalayan mountains in Sikkim.
2. It joins the river Brahmaputra in Assam.
3. Jalpaiguri town of West Bengal is situated on the banks of this river.

Which of the statements given above is/ are correct?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

129. Consider the following statements:
1. Mahi is the only major river in India that crosses the Tropic of Cancer twice.
2. Luni is the only major river in India that flows into the Rann of Kutch.
3. Tapi is the only major river in India that flows through a rift valley.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 1 only
(c) 2 and 3 only
(d) 1, 2 and 3

130. Consider the following states :
1. Karnataka
2. Kerala
3. Tamil Nadu
4. Andhra Pradesh
5. Telangana

Which of the above states form a part of the Cauvery River basin?
(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 3 and 4 only
(d) 1, 2, 3, 4 and 5

131. Consider the following information:

Waterfalls	Associated Rivers	Associated state
1. Kunchikal Falls	Varahi	Karnataka

2. Dudh Sagar Falls	Mandovi	Goa
3. Barehi-pani Falls	Sharavati	Maharashtra

In how many of the above rows is the given information correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

132. In the context of Indian drainage system, Kabini, Bhavani and Amravati are the tributaries of:
(a) Kaveri River
(b) Tungabhadra River
(c) Periyar River
(d) Penna River

133. Consider the following information:

River	Origin	Major Tributary
1. Godavari	Trimbakeshwar in Nashik district	Penganga
2. Krishna	Brahmagiri Hills in Kogadu district	Indravati
3. Mahanadi	Amarkantak Plateau in Annupur district	Kolar

In how many of the above rows is the given information correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

134. Consider the following rivers:
1. Ramganga
2. Gomati
3. Ghaghara
4. Gandak

Arrange the following rivers joining the Ganga downstream from West to East:
(a) 2-1-3-4
(b) 2-1-4-3
(c) 1-2-3-4
(d) 1-2-4-3

135. "This river is an important tributary of the Indus. It originates from a spring at Verinag, located at the foot of the Pir Panjal range. Flowing through Srinagar, it also passes through Wular Lake, the largest freshwater lake in India."

Which one of the following rivers is being described?
(a) Jhelum
(b) Chenab
(c) Ravi
(d) Beas

136. The Brahmaputra River passes through which of the following states in India?
1. Assam
2. Arunachal Pradesh
3. West Bengal
4. Manipur

Select the correct answer using the codes given below:
(a) 1 and 2 only
(b) 1, 2, and 3 only
(c) 2, 3, and 4 only
(d) 1,3, and 4 only

137. Which one of the following is an artificial lake?
(a) Kodaikanal (Tamil Nadu)
(b) Kolleru (Andhra Pradesh)
(c) Nainital (Uttarakhand)
(d) Renuka (Himachal Pradesh)

138. Consider the following pairs

River	Cultural Significance
1. Cauvery River	Aadi Perukku Festival
2. Pamba River	Mandala-Makaravilakku Festival
3. Shipra River	Kumbh Mela

Which of the statements given above is/are correct?
(a) 1 and 2 Only
(b) 2 and 3 Only
(c) 1 and 3 Only
(d) 1, 2 and 3

139. With reference to the Brahmaputra River which drains most of the part of North-Eastern India, Consider the following statements:
1. Lohit is the right bank tributary of Brahmaputra River.
2. More than 50% of the Brahmaputra basin is covered with water bodies.

3. Jaldhaka river joins it in the plains of Bangladesh.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

140. Which of the following river forms Inland drainage basin?
1. Kantu river
2. Sukri River
3. Sabarmati River
4. Ghaggar river
5. Kakni river

Select the correct answer using the code given below:
(a) 1 and 5 Only
(b) 2, 3 and 5 Only
(c) 1, 2, 3 and 4 Only
(d) 1, 2, 4 and 5 Only

141. The Brahmaputra, Irrawady and Mekong rivers originate in Tibet and flow through narrow and parallel mountain ranges in their upper reaches. Of these rivers, Brahmaputra makes a "U" turn in its course to flow into India). This "U" turn is due to
(a) Uplift of folded Himalayan series
(b) Syntaxial bending of geologically young Himalayas
(c) Geo-Tectonic disturbance in the tertiary folded mountain chains
(d) Both (a) and (b) above

142. Arrange the following west flowing rivers from north to south.
1. Kalinadi River
2. Mandovi River
3. Kajavi River
4. Ambika River

Which of the following sequence of rivers is correct?
(a) 3-4-1-2
(b) 2-3-4-1
(c) 4-3-2-1
(d) 3-4-2-1

143. The Narmada river flows to the west, while most other large peninsular rivers flow to the east. Why?
1. It occupies a linear rift valley.
2. It flows between the Vindhyas and the Satpuras.
3. The land slopes to the west from Central India.

Select the correct answer using the codes given below:
(a) 1 only
(b) 2 and 3
(c) 1 and 3
(d) None

144. Consider the following rivers:
1. Barak
2. Lohit
3. Subansiri

Which of the above flows/flow through Arunachal Pradesh?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

5.3. Indian Climate

145. Which among the following climate types is represented by the code 'BWh' as given in the Köppen climate classification?
(a) Tropical wet
(b) Subtropical dessert
(c) Tundra
(d) Humid subtropical

146. Which among the following can be considered as factors responsible for foggy weather in some parts of India during winter season?
1. Western disturbances
2. High variability in the wind speed
3. Supply of moisture from water bodies like rivers
4. Presence of PM 2.5 (Particulate Matter 2.5) particles in the air

Select the correct answer using the codes given below:
(a) 2 and 3 only
(b) 1, 3 and 4 only
(c) 2, 3 and 4 only
(d) 1, 2, 3 and 4

147. The intensity and the amount of Monsoon rainfall in India vary from one region to other. Consider the following statements in this regard:
1. The rain displays a declining trend from west to east over the west coast.
2. The rain increases from the southeast towards the northwest over the North Indian Plain.

3. In Rajasthan, the rainfall decreases from southeast towards the northwest.

Which of the statements given above is/are correct?
(a) 1 only
(b) 1 and 3 only
(c) 2 only
(d) 2 and 3 only

148. Consider the following statements regarding various local winds in India:
1. Kali Andhi are violent dust storms occurring in the northwestern parts of the Indo-Gangetic Plains.
2. Loo are the strong, cold and moist winds blowing during the night over the peninsular India.
3. Shamal are the hot and dry winds blowing over the coasts of Tamil Nadu during the summer season.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1 and 2 only

149. Consider the following statements regarding the Cold Weather Season in India:
1. Weak temperate cyclones from the Mediterranean Sea cause rainfall in the north-western parts of India.
2. The cold winds coming from Turkmenistan bring cold wave along with frost and fog over the northwestern parts of India.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

150. Consider the following statements regarding Indian Monsoon:
1. During Summer, intense low pressure in the north-western part of the subcontinent helps in the northward shift in the position of the Intertropical Convergence Zone (ITCZ).
2. The onset of monsoon in India denotes withdrawal of the easterly jet stream from its position over the north Indian plains.
3. The retreating southwest monsoon season is marked by a great fall in temperature.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1 and 2 only

151. Directions: In the question given below, there are two statements marked as Assertion (A) and Reason (R). Read the statements and choose the correct option:

Assertion (A): The neutral phase of the Southern Oscillation is linked to below average monsoon in India.

Reason (R): The neutral phase of the Southern Oscillation usually brings areas of high pressure to the western Indian Ocean.
(a) Both (A) and (R) are true and (R) is the correct explanation of (A).
(b) Both (A) and (R) are true and (R) is not the correct explanation of (A).
(c) (A) is correct but (R) is wrong.
(d) (A) is wrong but (R) is correct.

152. Consider the following statements:
1. The southwest monsoon is a continuation of the southeast trade winds.
2. The monsoon enters West Bengal from the south-westerly direction.
3. The passage of cyclonic depressions causes widespread rain during the season of retreating monsoon.
4. The Coromandel coast is situated parallel to the Bay of Bengal branch of southwest monsoon.

Which of the statements given above are correct?
(a) 1 and 3 only
(b) 2 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

153. With reference to Season of Retreating Monsoon in India, consider the following statements:
1. October heat is a weather condition associated with the retreating monsoon season.
2. The retreating southwest monsoon season is marked by clear skies and rise in temperature.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

154. Which of the following is/are the reasons behind the occurrence of dry spells of monsoons?

1. Less frequency of rain-bearing storms along the Inter Tropical Convergence Zone
2. Blowing of the monsoon winds parallel to the west coast
3. Southward shifting of the monsoon trough
4. Pressure gradient at Gangetic plains weakens

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2, 3 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

155. With reference to the effects of monsoon on lives of Indian people and the economy of India, consider the following statements:

1. The unique wetland agriculture practiced in Marathwada region is attributed to the Monsoon rains.
2. Monsoon rainfall is a major source of soil erosion in India.
3. Winter rainfall by Monsoons in north-western India is highly beneficial for rabi crops.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 2 and 3 only

156. With reference to the climatic regions of India according to Koeppen's scheme, consider the following pairs:

Type of Climate	Area
1. Monsoon with short dry season	West coast of India south of Goa
2. Monsoon with dry summer	Coromandel coast of Tamil Nadu
3. Tropical savannah	western Rajasthan
4. Monsoon with dry winter	Most of North-east India
5. Cold humid winter with short summer	Arunachal Pradesh

How many pairs given above are correctly matched?

(a) Only two
(b) Only three
(c) Only four
(d) All five

157. Consider the following pairs:

Local storm	Characteristic
1. Blossom Shower	Useful for coffee plantation
2. Mango Shower	Post-monsoon showers
3. Nor Westers	Evening thunderstorms in Assam
4. Loo	A hot and dry summer wind

How many pairs given above are correctly matched?

(a) Only one pair
(b) Only two pairs
(c) Only three pairs
(d) All four pairs

158. In context of the rainfall patterns in India during Winter season, consider the following statements:

1. During winters, the inflow of cyclonic disturbances from the west brings rainfall to the northern plains.
2. Winter winds are associated with anticyclonic circulation which reduces the chances of cloud formation and precipitation.
3. Northeast monsoon winds cause rainfall in certain parts of Southern India like Rayalaseema.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

159. With reference to South-West monsoon winds, consider the following statements:

1. The convergence of the Arabian Sea and Bay of Bengal branches of the monsoon occurs in the State of Punjab.
2. Monsoon winds approach the State of West Bengal from the South and Southeast direction.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

160. Consider the following statements:

Statement-I: In contrast to Northern India, Peninsular India does not have a well-defined cold weather season.

Statement-II: Peninsular India is surrounded by the Arabian Sea on the east and the Bay of Bengal on the west.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect, but Statement-II is correct.

161. With reference to various climatic phenomenon influencing monsoon rainfall in India, consider the following statements:

1. El Nino generally leads to high intensity monsoon rainfall in India.
2. The easterly jet stream plays a crucial role in monsoon rainfall distribution by steering the tropical depressions into India.
3. The convective phase of Madden-Julian Oscillation (MJO) over the Indian ocean drastically reduces the amount of monsoon rainfall in India.

Which of the statements given above is/are correct?

(a) 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) None of the above

162. With reference to the Indian Climate, consider the following statements:

1. Due to their location at the same latitude, Agra and Darjeeling have similar climate.
2. Places lying in the coastal peninsular areas of India hardly experience the winter season.
3. The Arabian Sea branch of the south-west monsoon winds induces rainfall in western Rajasthan.

Which of the statements given above is/are correct?

(a) 2 only
(b) 3 only
(c) 1 and 3 only
(d) 2 and 3 only

163. The reversal of winds from northeast to south and southwest direction during the Northeast monsoon in India is due to:

(a) the weakening of the Coriolis force.
(b) the southward shift of the Intertropical Convergence Zone (ITCZ).
(c) the formation of a low-pressure system over the Himalayas.
(d) the warming of the Indian landmass compared to the Indian Ocean.

164. Consider the following statements:

Statement-I: Generally, Frequency of tropical cyclones is more in the Bay of Bengal than in Arabian sea.

Statement-II: Sea surface temperatures over the Arabian Sea has been increasing in recent times.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

165. Consider the following statements regarding various geographical phenomena and their impact on Indian monsoon:

1. The easterly jet stream descends over the Indian Ocean (near Madagascar), and intensifies the high pressure system, driving the southwest monsoon towards India.
2. Presence of anticyclonic conditions in the Tibetan plateau during summers in India strengthen the Indian Monsoon.
3. Cyclones formed in the Arabian sea enhance the progression of monsoon, whereas Cyclones formed in the Bay of Bengal typically suppress it.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

166. Consider the following states in India:

1. Gujarat
2. Odisha
3. Jharkhand
4. Rajasthan
5. Karnataka

In how many of the above states Semi-Arid steppe climate is found as per Koeppen's classification?

(a) Only two
(b) Only three
(c) Only four
(d) All five

167. In the context of Indian monsoon, consider the following statements:

Statement I: There are large variations in the total amount of rainfall from year to year.

Statement II: Rainfall variability is highest where the amount of rainfall is lowest.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement- I
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I
(c) Statement-I is correct but Statement-II is incorrect
(d) Statement-I is incorrect but Statement-II is correct

168. Consider the following statements:

Statement-I: Cherrapunji and Mawsynram are the two wettest places on the earth, receiving over 1000 cm of rainfall annually.

Statement-II: Mawsynram and Cherrapunji are located at the high-altitude on southern slope of Khasi hills with funnel shaped catchment area.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

169. With reference to the climate phenomenon known as 'Norwesters', consider the following statements:

1. They are generally evening thunderstorms that occur in the region of Assam and West Bengal.
2. They occur typically after the monsoon season and most prevalent in the months of October and November.
3. They play an instrumental role in tea and rice cultivation in the various regions.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 3 only
(c) 3 only
(d) 2 and 3 only

170. With reference to the Western cyclonic disturbances and its impact on Indian Climate, consider the following statements:

1. They originate over the Arabian Sea branch of the Indian Ocean.
2. They are primarily transported into India by the prevailing trade winds in the Sub tropical areas.
3. They majorly cause rainfall in Northern parts of India during the Winter.

Which of the statements given above is/are **incorrect**?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

171. With reference to the Retreating Monsoon Season, consider the following statements:

1. The apparent movement of the Sun towards the Tropic of Capricorn is the primary reason attributed to this season.
2. This season is marked by the absence of any kind of cyclonic activity across India.
3. The coastal areas of Tamil Nadu receive most of their rainfall during this season.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 3 only
(c) 3 only
(d) 2 and 3 only

172. Which one of the following statements is correct regarding the impact of the Easterly jet stream over the Indian climate?

(a) It is responsible for the severe winter season in the Indian subcontinent.
(b) It is responsible for the burst of monsoon in India.
(c) It has a direct relation to the occurrence of heatwaves in the region.
(d) It is responsible for the rainfall over coastal Tamil Nadu and adjoining south coastal Andhra Pradesh.

173. Consider the following:

1. These are evening local level thunderstorms in the months of March and April.
2. These occur in the region of West Bengal and Assam.
3. The showers associated with these storms are sometimes useful for tea, jute and rice cultivation."

Identify the local storms of the hot weather season in India from the statements given above?

(a) Mango Showers
(b) Loo
(c) Nor Westers
(d) Blossom Showers

174. In the context of south west monsoon season in India, consider the following statements:

Statement I: The monsoon enters West Bengal and Bangladesh from south and southeast instead of from the south-westerly direction.

Statement II: The Arakan hills along the coast of Myanmar deflects the Bay of Bengal branch of the monsoon towards India.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II does not explain Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

175. With reference to Indian geography, which of the following is/are considered as the characteristic feature(s) of Indian monsoon rainfall?

1. Monsoon rainfall is largely influenced by the seasonal reversal in the wind direction.
2. In the Ganga valley, the rainfall intensity decreases from the east to the west.

Select the correct answer using the code given below:

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

176. As per Koeppens classification, In India, in which areas the Semi-Arid steppe type climate is found?

1. Rain shadow regions of the Western Ghats
2. Coromandel Coast of Tamil Nadu
3. Malwa Plateau in Central India
4. Certain regions of Haryana and Punjab

Select the correct answer using the code given below

(a) 1, 2, and 3 only
(b) 2, 3, and 4 only
(c) 1 and 3 only
(d) 1 and 4 only

177. With reference to South west monsoon in India, consider the following statements:

Statement I: The Tamil Nadu coast remains mostly dry during the South West Monsoon season.

Statement II: The Tamil Nadu coast lies in the rain shadow area of Bay of Bengal branch of the South West Monsoon.

Statement III: The Tamil Nadu coast is situated parallel to the Arabian sea branch of the South West Monsoon.

Which one of the following is correct in respect of the above statements?

(a) Both Statement II and Statements III are correct and both of them explain Statement I.
(b) Both Statement II and Statement III are correct but only one of them explains Statement I.
(c) Only one of the Statements II and III is correct and that explains Statement I.
(d) Neither Statement II nor Statement III is correct.

178. Consider the following information:

Local winds/ storms	Area of occurrence	Impact on agriculture
1. Blossom showers	Kerala	Benefits coffee cultivation

2. Nor Westers	Bengal and Assam	Cause severe disruption to the tea cultivation
3. Loo	Punjab and Haryana	Facilitates in wheat harvesting.

In how many of the above given rows, the information is correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

179. October to December are among the favorable months for the development of cyclones in the Bay of Bengal and the Arabian Sea. Which of the following are the reasons for this?

1. Retreating Monsoon and weak Wind Shear
2. Conducive Sea Surface Temperatures
3. Low humidity in mid-troposphere
4. Shifting of Intertropical Convergence Zone towards North of the gangetic plains.

Select the correct answer using the codes given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1, 3 and 4

180. With reference to Indian Climate, consider the following statements:

1. The northeast trade winds blow from land to sea in North India during the winter season.
2. There is no counter-equatorial current in the Indian ocean during winters.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

181. Which of the following is the effect of El Nino Southern Oscillation (ENSO) on Indian climate?

(a) The El Nino effect makes winter weather conditions harsher over the Northern plains.
(b) It has no impact on the development of cyclones in the Bay of Bengal region.
(c) It determines the strength of southwest monsoons in India.
(d) It is the major cause for the seasonal reversal of winds in the Indian ocean.

182. Consider the following statements with respect to the jet streams:

1. The subtropical westerly jet streams blowing over India in winter intensifies the northeast monsoons.
2. The jet streams impact the time of onset of southwest monsoons.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

183. Which of the following is/are the reasons for the absence of well-defined winter season in Peninsular India?

1. Moderating influence of the sea
2. Higher atmospheric pressure over the peninsular region
3. Proximity of the peninsular landmass to equator

Select the correct answer using the code given below:

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

184. Consider the following statements:

1. The duration of the monsoon decreases from southern India to northern India.
2. The amount of annual rainfall in the northern plains of India decreases from east to west.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

185. With reference to 'Indian Ocean Dipole (IOD)' sometimes mentioned in the news while forecasting Indian monsoon, which of the following statements is/are correct?

1. IOD phenomenon is characterised by a difference in sea surface temperature between tropical Western Indian Ocean and tropical Eastern Pacific Ocean.

2. An IOD phenomenon can influence an El Nino's impact on the monsoon.

Select the correct answer using the code given below:
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

186. Which of the following statements is/are correct regarding the impact of climate change?
1. Sea-surface temperature of Indian Ocean may increase by 1 to 2°C leading to intensification of cyclones.
2. There are likely to be 300 days in a year with maximum temperatures above 35°C in case of 1.5 to 2°C global warming.
3. El Nino–Southern Oscillation will lead to rainfall variability and compounded events in coming decades.

Select the correct answer using the code given below:
(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 3 only

5.4. Natural Vegetation

187. Consider the following statements with respect to Tropical Dry Deciduous forests:
1. They are found in regions with an annual precipitation of less than 50cm.
2. In this type of forest, the trees shed their leaves at the onset of the dry season.
3. These forests are home to Mahogany and Ebony species of trees.

Which of the statements given above is/are correct?
(a) 2 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) None of the above

188. Consider the following States:
1. Arunachal Pradesh
2. Himachal Pradesh
3. Mizoram

In which of the above States do 'Tropical Wet Evergreen Forests' occur?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

189. With reference to the Khejri Tree, consider the following statements:
1. It covers about two-thirds of the total geographical area of Rajasthan.
2. The fruit of this tree is used to make the very popular local dish 'Sangri'.
3. The tree has inspired the Chipko Movement.
4. It is the state tree of Rajasthan.

Which of the statements given above is/are correct?
(a) 1,2 and 4 only
(b) 2 and 3 only
(c) 1,3 and 4 only
(d) 1, 2, 3 and 4

190. If you pass through this region, you are most likely to find tall grasslands, scrub savannah, sal forests clay rich swamps and high biological diversity. Due to the very high humidity, this region is very marshy. Most of the region lies especially in Punjab, Uttar Pradesh and Uttarakhand, and has been turned into agricultural land which gives good crops of sugarcane, rice and wheat. You are likely in the belt of:
(a) Bhabar
(b) Khadar
(c) Terai
(d) Bhangar

191. In India, in which one of the following types of forests is teak a dominant tree species?
(a) Tropical moist deciduous forest
(b) Tropical rain forest
(c) Tropical thorn scrub forest
(d) Temperate forest with grasslands

192. Which of the following is/are the features of wet tropical evergreen vegetation?
1. Dense Forest with thick spread of grass.
2. Low vegetal species per unit area.
3. Found in north-eastern hills in India.
4. Plants found are Mahogony, Cinchona and Bamboos.

Select the correct answer using the code given below:
(a) 1, 2 and 4 only
(b) 3 and 4 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

193. In India, Tropical Wet Evergreen forests are predominantly found in which of the following regions?
1. Western slopes of Western Ghats
2. Purvanchal Hills

3. Northwestern Rajasthan.
4. Andaman and Nicobar Islands.

Select the correct answer from the code given below:

(a) 1, 2, 3 and 4
(b) 1, 2 and 4 only
(c) 3 and 4 only
(d) 1 and 2 only

194. Consider the following statements about Alpine Forests in India:

1. In India, they are only found in the Eastern Ghats.
2. Silver fir, and junipers are the common vegetation that can be found in this type of forests.
3. They form more than 20 percent of the total Forest Area in India

Which of the statements given above is/are **incorrect?**

(a) 1 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 2 and 3 only

195. Which of the following trees are the characteristic trees of the Tropical Evergreen forests of India?

1. Mahogany
2. Sandalwood
3. Babul

Select the correct answer using the code given below:

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1 only

196. Why are the western slopes of Western Ghats covered with dense forest in comparison to the eastern slopes?

(a) Due to the large presence of the Rocky Mountains on the Eastern slopes.
(b) Western slopes receive much less sunlight as compared to Eastern Slopes.
(c) Eastern slopes are on the leeward side of the Western Ghats and hence receive scanty rainfall.
(d) Forest at the Eastern slopes got cut down because of industrial purposes.

197. Consider the following statements regarding the various Medicinal plants in India:

1. Patwa is a Himalayan medicinal shrub having antioxidant properties.
2. Himalayan Fritillary can be used in the treatment of bronchial disorders and pneumonia.
3. Salampanja is used in the treatment of dysentery and chronic fever.

Which of the statements given above are correct?

(a) 1, 2 and 3
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1 and 3 only

198. In which of the following highlands of India, the 'Shola Forests' are most likely to be found?

(a) Jaintia Hills
(b) Aravalli Hills
(c) Nilgiris Hills
(d) Vindhya Hills

199. With reference to the characteristics of Mangroves, consider the following statements;

1. They cannot grow in fresh waters.
2. They absorb and store large amounts of carbon dioxide from the atmosphere.
3. They can play an important role in reducing heavy metal pollution in water by absorbing certain heavy metals.

Which of the statements given above is/are correct?

(a) 1, 2 and 3
(b) 2 and 3 only
(c) 2 only
(d) 3 only

200. With reference to the important medicinal plants of India, consider the following pairs:

Medicinal Plants	Uses
1. Kachnars	To treat asthma
2. Arjun	To treat earache
3. Sarpagandha	To treat insomnia
4. Himalayan fritillary	To treat pneumonia

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

201. Consider the following trees:
1. Babul (Vachellia nilotica)
2. Neem (Azadirachta indica)
3. Rosewood (Dalbergia sissoo)

How many of the above trees are found in tropical evergreen forests of India?
(a) Only one
(b) Only two
(c) All three
(d) None

202. Consider the following statements with respect to Forest conservation act, 1980:
1. Under the provisions of this Act, prior approval of the Central government is essential for diversion of forest lands for the non-forestry purposes.
2. It introduced the concept of reserved forests, protected forests and village forests.
3. The power to make rules under the act lies with respective State governments.
4. It contained provisions regarding constitution of Forest advisory committee.

Which of the statements given above are correct?
(a) 1 and 4 only
(b) 2 and 3 only
(c) 1, 2 and 4 only
(d) 1, 3 and 4 only

203. Consider the following statements with respect to natural vegetation in India
1. The majority of Indian forests are dominated by hardwoods.
2. India's average timber yield is on par with the global average.
3. The total Forest cover in tiger reserves of India has increased in the last decade.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 3 only

204. With reference to Indian forests, the plants named "Strychnine, Aconite & Datura" are related to which of the following?
(a) They are medicinal plants.
(b) They are commonly used as tanning material.
(c) They are edible plants.
(d) They are toxic plants.

205. With reference to 'Reserve Forests' in India, consider the following statements:
1. They constitute more than half of the total recorded forest area in India.
2. Generally, activities like grazing cattle and hunting are banned in these forests.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

206. Consider the following items:
1. Bamboo
2. Canes
3. Medicinal plants
4. Timber
5. Cocoon

How many of the above are considered as Minor Forest Produce (MFP) under the Forest Rights Act, 2006?
(a) Only two
(b) Only three
(c) Only four
(d) All five

207. Consider the following states in India:
1. Andhra Pradesh
2. Gujarat
3. Odisha
4. Maharashtra

As per the India State of Forest Report 2023, which of the following is the correct decreasing order based on the mangrove cover in the state?
(a) 2-3-4-1
(b) 3-2-1-4
(c) 2-1-4-3
(d) 3-1-2-4

208. Consider the following trees:
1. White Cedar
2. Mahua
3. Gurjan

How many of the above given trees are primarily found in Evergreen Forests in India?
(a) Only one
(b) Only two
(c) All three
(d) None

209. In the context of natural vegetation, how is tree cover different from forest cover?
(a) Tree Cover includes all tree patches less than one hectare outside recorded forest

areas, while Forest Cover includes all areas over one hectare with more than 10% canopy density.
(b) Tree Cover consists of scattered trees, while Forest Cover includes only dense, continuous forests.
(c) Tree Cover refers to man-made plantations, whereas Forest Cover includes only natural forests.
(d) Tree Cover includes all areas over one hectare with more than 10% canopy density while Forest Cover includes all tree patches less than one hectare outside recorded forest areas.

210. A particular state in India has the following characteristics:
1. The forest cover in the state accounts for more than 75% of its geographical area.
2. The state has significant limestone and coal deposits.
3. It is known for living root bridges constructed by indigenous communities.

Which one among the following states has all the above characteristics?
(a) Nagaland
(b) Meghalaya
(c) Arunachal Pradesh
(d) Mizoram

211. It is a deciduous tree with broad trunks and compact tops. In India, it is mainly found in Madhya Pradesh. It is also known as the "upside-down tree".

This description refers to which of the following species of trees?
(a) Tendu
(b) Cinchona
(c) Juniper
(d) Baobab

212. Arrange the following types of vegetation in descending order based on their areawise share in India's total forest cover:
1. Tropical Moist Deciduous Forests
2. Tropical Dry Deciduous Forests
3. Tropical Wet Evergreen Forests
4. Tropical Thorn Forests

Select the correct answer using the codes given below:
(a) 2 - 1 - 3 - 4
(b) 1 - 2 - 3 - 4
(c) 2 - 1 - 4 - 3
(d) 1 - 2 - 4 - 3

213. If you travel through the Himalayas, you are likely to see which of the following plants naturally growing there?
1. Oak
2. Rhododendron
3. Sandalwood

Select the correct answer using the code given below.
(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

5.5. Soils

214. Consider the following statements regarding the Soil Alkalinity:
1. It occurs when the pH value of the soils declines below 6.
2. In general, it results in a reduction of agricultural productivity.
3. Salt tolerant crops cannot be grown on alkaline soils.

Which of the statements given above is/are correct?
(a) 2 only
(b) 1 only
(c) 2 and 3 only
(d) 1 and 2 only

215. Consider the following statements with reference to the features and characteristics of Mountain Soils:
1. Mountain soils are typically shallow, with a limited depth.
2. Mountain soils usually have a high organic matter content.
3. The nutrient content of mountain soil is always very high.
4. Mountain soils are generally acidic in nature.

Which of the above given statements are correct?
(a) 2, 3 and 4 only
(b) 1, 2 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2 and 3 only

216. Which among the following soils in India are poor in nitrogen content?
1. Black soil
2. Red and yellow soil
3. Arid soil
4. Laterite soil

Select the correct answer from the codes given below:
(a) 1 and 3 only
(b) 2 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

217. Read the following paragraph about a soil type found in India:

"This soil is formed under conditions of high temperature and heavy rainfall with alternate wet and dry periods. This soil hardens greatly on losing moisture. The continuous stretch of this soil is found on the summits of Western Ghats at 1000 to 1500 m above mean sea level, Eastern Ghats, the Rajmahal Hills, Vindhyan, Satpuras and Malwa Plateau. It lacks fertility due to intensive leaching but when manured and irrigated, it is suitable for growing plantation crops like tea, coffee, rubber, cinchona, coconut and arecanut."

Which of the following soil types is described in the above paragraph?
(a) Red Soil
(b) Black Soil
(c) Laterite Soil
(d) Alluvial Soil

218. Consider the following statements with reference to the Contour Ploughing:
1. In this practice, ploughing is done perpendicular to the slope.
2. It is helpful in water conservation.
3. It can lead to decreased usage of fertilizer.

Which of the above given statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

219. With reference to Indian soils, consider the following statements:
1. Laterite soils are rich in Volcanic ash content.
2. Peninsular soils have High content of Iron oxide.
3. Peaty soils have large amounts of organic material.

Which of the statements given above is/are correct?
(a) 1 and 3 only
(b) 2 only
(c) 2 and 3 only
(d) 1, 2, and 3

220. "This soil is formed in hilly and forest areas where sufficient rainfall and vegetation are available. The soils vary in structure and texture depending on the mountain environment where they are formed. They are loamy and silty on valley sides and coarse-grained on the upper slopes. In the snow-bound areas of the Himalayas, they experience denudation and are acidic with low humus content. The soils found in the lower valleys are fertile."

The above paragraph refers to which of the following soil types?
(a) Forest soil
(b) Arid soil
(c) Red soil
(d) Laterite soil

221. With reference to Black Soils of India, consider the following statements
1. Black soils are mostly found in the peninsular plateau of India.
2. Black soils are rich in lime but lack phosphorus and organic matter.
3. Black soils are generally clayey and impermeable.
4. Black soils are not at all suitable for cultivation during dry season.

Which of the statements given above are correct?
(a) 1 and 3 only
(b) 2 and 4 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

222. In the context of the Laterite Soil and the Red Soil, consider the following statements:
1. Like Laterite soils, Red Soils also develop only in areas with high temperatures and high rainfall.
2. Laterite soils are generally less fertile than Red Soils due to high leaching.
3. Both the Red soils and the Laterite soils are poor in nitrogen, phosphorus, and humus.

Which of the following statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

223. With reference to the Peaty and the Saline Soils, consider the following statements:
1. Unlike Saline soil, Peaty soils are mostly found in arid and semi-arid regions.

2. Both Saline soil and Peaty soil have a poor presence of humus and organic matter.
3. Both Peaty soil and Saline soil do not support any vegetative growth.

Which of the statements above is/are correct?
(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 only
(d) None of the above

224. Consider the following statements:

Statement-I: Intensive farming practices like excessive irrigation can turn rich, fertile alluvial soils into saline areas.

Statement-II: Excessive irrigation raises the water table and brings dissolved salts closer to the surface, leading to salt accumulation in the topsoil.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

225. Consider the following statements with respect to the Peaty soils:

1. They are found predominantly in the areas of heavy rainfall and high humidity.
2. They are rich in humus and organic content.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

226. Consider the following statements in respect of Laterite soil:

Statement-I: Laterite soils are poor in iron oxide but rich in humus content.

Statement-II: Laterite soils are formed mainly in regions of high rainfall and high temperature.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct, and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct, and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct, but Statement-II is incorrect.
(d) Statement-I is incorrect, but Statement-II is correct.

227. The soil salinity and alkalinity in the country is particularly visible on a large scale in many parts of India. In this context, consider following statements:

1. Over-irrigation can lead to both salinization and alkalization of soil.
2. Treatment of topsoil with gypsum can reduce alkalization of soil.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

228. With reference to soil types, Thur , Kakar and Chopan are different names of which soil type?
(a) Alluvial soil
(b) Laterite soil
(c) Saline and alkaline soil
(d) Peaty and marshy soil

229. In the context of Laterite soils of India, consider the following statements:

1. Laterite soils are generally deficient in Nitrogen.
2. Laterite soils are suitable for growing plantation crops like tea and coffee.
3. Laterite soils are well developed in the Himalayan region of India.

Which of the above given statements is/are correct?
(a) 2 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

230. Consider the following Agricultural practices:

1. Roughening the land surface.
2. Practicing Monocropping.
3. Building embankments parallel to the slope.
4. Practicing Intensive tillage.
5. Planting crops perpendicular to the wind direction.

How many of the above practices can help in controlling soil erosion?

(a) Only two
(b) Only three
(c) Only four
(d) All five

231. Consider the following statements regarding the Alluvial soils:

1. In India, these soils cover more than 40% of the total land area.
2. They are suitable for agricultural crops due to very high nitrogen content in the soil.
3. The sand content in the Alluvial soils decreases from the west to east.

Which of the above given statements is/are correct?

(a) 2 only
(b) 1 and 2 only
(c) 3 only
(d) 1 and 3 only

232. With reference to Khadar soil and Bhangar soil, consider the following statements:

1. Khadar soil is formed by the deposition of older alluvium, while Bhangar consists of fresh alluvium.
2. Kankar formation is higher in the Khadar soil than in the Bhangar soil.
3. Khadar soil is less fertile than Bhangar soil, due to poor drainage capacity of the khadar soil.

Which of the above given statements is/are **incorrect**?

(a) 2 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

233. With reference to the laterite soils, consider the following statements:

Statement-I: Laterite soils are widely cut as bricks for use in house construction.

Statement-II: Laterite soils are poor in iron oxide but rich in humus content.

Statement-III: These soils develop wide cracks during dry season and is associated with self-ploughing.

Which one of the following is correct in respect of the statements given above?

(a) Both statement -II and statement -III are correct and both of them explain statement -I.
(b) Both statement -II and statement -III are correct, but only one of them explains statement -I.
(c) Only one of the statements II and III is correct, and that explains statement -I.
(d) Neither Statement -II nor statement -III is correct.

234. Consider the following soil types:

1. Alluvial Soils
2. Red Soils
3. Mountain Soils
4. Arid Soils

How many of the above soil types are generally characterized by a high humus content?

(a) Only one
(b) Only two
(c) Only three
(d) All four

235. These are thick deposits of alluvial soil found in the valley of Kashmir. They are formed during the Pleistocene period. Upliftment of Pir Panjal range led to their formation. They are ideal for the cultivation of saffron, almonds, apples and several other cash crops.

The above paragraph best describes which one of the following?

(a) Karewas
(b) Bhabar
(c) Dooars
(d) Duns

236. Consider the following statements:

Statement I: Excessive irrigation in dry climatic conditions results in increased salinity of soils.

Statement II: Capillary action in soil draws groundwater up towards the soil surface, where the water evaporates.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I
(b) Both Statement-I and Statement-II are correct, but Statement-II does not explain Statement-I
(c) Statement-I is correct, but Statement-II is incorrect
(d) Statement-I is incorrect, but Statement-II is correct

237. Consider the following statements with respect to the Black soil:

1. It is highly retentive of moisture.

2. They are rich in phosphorus, nitrogen and organic matter.
3. Black soils of uplands are of low fertility but they are fertile in the valleys.
4. Cotton, millets and sugarcane are some of the important crops grown in this soil.

Which of the statements given above are correct?

(a) 1, 3 and 4 only
(b) 1, 2 and 3 only
(c) 1 and 3 only
(d) 4 only

238. Consider the following statements with respect to the Mountain Soils:

1. It is heterogeneous in nature and its character changes with parent rocks.
2. They are rich in humus but are deficient in potash.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

239. With respect to the Land Degradation and Desertification in India, consider the following statements.

1. India witnessed an increase in the level of desertification in majority of the states and Union territories in the last decade.
2. Vegetation degradation is found to be responsible for about 50% of desertification in the country.
3. Water erosion resulting in Badland Topography is an initial stage of desertification.
4. Sand encroachment by wind, reduces fertility of the soil making the land susceptible to desertification.

Which of the following statements given above is/are correct?

(a) 1, 2 and 3 only
(b) 1, 3 and 4 only
(c) 2, 3 and 4 only
(d) 1, 2 and 4 only

■■■

SOLUTIONS

5.1. Location and Physiography

1. Solution: (d)

Exp) Option d is the correct answer.

The Great Northern Plains is made up of the soils brought down and deposited by the rivers flowing from the Himalayas in the North and the Great Indian plateau in the South.The plains are categorized in different regions based on their features.

Pair 1 is correct. The newer, younger deposits of the flood plains are called **khadar**. They are renewed almost every year and so are fertile, thus, ideal for intensive agriculture.

Pair 2 is correct. Bhangar is the largest part of northern plain and is composed of the oldest alluvial soil. They lie above the flood plains and resemble terraces. The soil of this region is locally known as **kankar** and is composed of **calcareous deposits**.

Pair 3 is correct. There is a strip of plain about 10-15 km broad along the outer slopes of the Siwaliks in Punjab, Haryana and Uttar Pradesh. This region is known as **'bhabar'**. This strip of bhabar is made of gravel and coarse sand. The **smaller streams disappear** under ground in the 'bhabar' region during the summer season and their water surfaces again after crossing the bhabar.

2. Solution: (a)

Exp) Option a is the correct answer.

The Himalayas are the young-fold mountains consisting of several hill ranges, extending from the northwest of India to the East. They not only act as a physical barrier but also as a climatic, drainage and cultural divide.

Statement 1 is correct: Himalayas are the youngest fold mountains of India. They were formed due to collision between the Indo-Australian and the Eurasian plate. They are fold mountains which stretch over the northern borders of the Indian subcontinent.

Statement 2 is incorrect: Marmolada glacier is not located in the Himalayas. It is located in the Alps Mountain ranges. The prominent glaciers in the Himalayas are Baltoro and Siachin among others.

Statement 3 is incorrect: The longitudinal valleys present in the Himalayan regions are known as duns. Such as Jammu dun and Pathankot dun. However, duars are the alluvial floodplains in northeastern India that lie south of the outer foothills of the Himalayas and north of the Brahmaputra River basin.

Duars, also spelled **Dwars** or **Dooars**, region of northeastern India, at the foot of the east-central Himalayas. It is divided by the Sankosh River into Western and Eastern Duars.

Statement 4 is correct: The most distinctive feature of the Himalayas is the **crustal thickness**, which increases from about 35 to 40 km in the **Indus-Ganga-Brahmaputra Plains** to between 65 and 80 km over the **Greater Himalayas**

3. Solution: (c)

Exp) Option c is the correct answer.

Correct order from North to South is: Mishmi – Dafla – Mikir – Lushai. Hence, option c is correct the answer.

Option 2: Mishmi Hills: These are located at the north-eastern tip of India, in north-eastern Arunachal Pradesh.

Option 3: Dafla Hills: These are located on the border of western Arunachal and Assam occupied by an independent tribe called Daphla.

Option 1: Mikir Hills: These are a group of hills located to the south of the Kaziranga National Park, Assam. The easternmost Meghalaya comprising the detached Mikir Hills is partly isolated being surrounded by three sides. Karbi plateau or Mikir Hills is known oldest landform in Assam.

Option 4: Lushai Hills: These are a mountain range in Mizoram and Manipur, India. The range is part of the Patkai range system.

4. Solution: (a)

Exp) Option a is the correct answer.

Types of Thrust	Located Between	
1. Main Frontal Thrust (MFT)	Between Shiwalik Himalayas and Northern Plain	Hence, Pair 1 is correct.
2. Main Central Thrust (MCT)	Between the Greater Himalayas and Lesser Himalayas	Hence, Pair 2 is incorrect.
3. Main Boundary Thrust (MBT)	Between the Lesser Himalayas and Shiwalik Himalayas	Hence, Pair 3 is incorrect.

5. Solution: (b)

Exp) Option b is the correct answer.

India's geographical land area can be classified into: Archaean System, Dharwar System, Cuddapah System, Vindhyan System, Gondwana System, Deccan Trap, Tertiary System and Quaternary System.

Statement 1 is incorrect: Archean rocks, also known as Pre-Cambrian rocks are the oldest rocks of the earth's crust. This period marks the development of first photosynthesis, the life support atmosphere. **The Archean rocks in India are found in Aravallis mountains, 2/3rd of the Deccan peninsula and some parts of north east. So, it is not limited to only Aravallis region.** These rocks have abundant metallic and non-metallic minerals such as iron, copper, manganese, bauxite, lead, zinc, gold, silver, tin, tungsten, mica, asbestos, graphite etc.

Statement 2 is correct: Cuddapah System rocks have been formed as a result of erosion and sedimentation of the rocks of Dharwar system, these are also sedimentary rocks. The rocks have been named after the district of **Cuddapah in Andhra Pradesh** where these are semi-circular in expansion. These are famous for sandstone, limestone, quartzite, slate, marble and asbestos. The Cuddapah rocks are also found in Rajasthan, Chhattisgarh, Delhi and the lesser Himalayas. **One of the important series of Cuddapah System is Papaghani series**, named after the river of same name in Andhra Pradesh.

Statement 3 is correct: Vindhyan System have been formed after the cuddapah rocks by the deposition of silt of river valleys and shallow oceans, these rocks are also sedimentary rocks. The rocks are largely **devoid of metalliferous minerals,** but provides large quantities of durable stones, ornamental stones, limestone, pure glass making sand etc. This system rocks are extensively distributed in India from Chittorgarh (Rajasthan) to Sasaram (Bihar). These rocks are found in the Vindhyas, e.g. the Malwa plateau, the Semari range in the Son valley, Bundelkhand etc. **This rock system is famous for house-building rocks.** The Sanchi Stupa, the Red Fort, the Jama Masjid etc are built with the red sandstone of this structure.

6. Solution: (b)

Exp) Option b is the correct answer.

Western Himalayas lies approximately between the Indus in the west and the Kali River in the east (880 km). These Himalayas spread across three states of Jammu and Kashmir, Himachal Pradesh and Uttarakhand.

Statement 1 is correct: All the three ranges of Himalayas are prominent in the region of Himachal and Uttarakhand Himalayas. These are the Great Himalayan range, the Lesser Himalayas and the Shiwalik range from the North to the South.

Statement 2 is incorrect: The Lesser Himalayas is locally known as Dhaoladhar in Himachal Pradesh and **Nagtibha in Uttarakhand** (Not Shiwalik Himalayas).

Statement 3 is correct: Bhotiyas are people of presumed Tibetan heritage that live along the Indo-Tibetan border in the **upper reaches of the Great Himalayas.** They were primarily traders and involved in the Indo-Tibetan trade. But when the trade stopped after 1962 due to Indo-China war, they were left without any job. The government later on recognised the tribe as Scheduled Tribe and offered them benefits in education and service industry.

Statement 4 is correct: Bahaks/Margs are the summer grasslands in **Jammu and Kashmir**. These are small grasslands on the slopes of Lesser Himalayan range. Whereas **'Bugyals'** are the summer grasslands of Bhotias in the state of Uttarakhand in the higher reaches.

7. Solution: (b)

Exp) Option b is the correct answer.

Ghats are two mountain ranges forming the eastern and western edges of the Deccan plateau of peninsular India. The two ranges run roughly parallel to the Bay of Bengal and Arabian Sea coasts, respectively, from which they are separated by strips of fairly level coastal land.

Statement 1 is incorrect: Western Ghats are comparatively higher in elevation and **more continuous than the Eastern Ghats.** Their average elevation is about 1,500 m with the height increasing from north to south. **Eastern Ghats comprising the discontinuous and low hills** are highly eroded by the rivers such as the Mahanadi, the Godavari, the Krishna, the Kaveri, etc.

Statement 2 is incorrect: Western Ghats has an exceptionally high level of biological diversity and endemism and is recognized as **one of the world's eight 'hottest hotspots' of biological diversity**. The forests of the site include some of the best representatives of non-equatorial tropical evergreen forests anywhere and are home to at least 325 globally threatened flora, fauna, bird, amphibian, reptile and fish species.

Statement 3 is correct: Eastern Ghats are older than the Western Ghats and have a complex geologic history. Eastern Ghats were formed during the breakup of the supercontinent Rondinia 600 - 700 million years ago, while the Western Ghats were formed more recently when the supercontinent Gondwana broke up about 150 million years ago. **The Western Ghats are on average several thousand feet higher than the Eastern Ghats primarily because they are hundreds of millions of years younger.**

8. Solution: (a)

Exp) Option a is the correct answer.

Name of Passes	Connects	
Aghil Pass	Ladakh region with the Xinjiang Province of China.	**Hence, Pair 1 is correct.**
Pensi La	Connect Kashmir Valley and Kargil. It is known as the Gateway to Zanskar.	**Hence, Pair 2 is correct.**
Mangsha Dhura	Uttarakhand with Tibet. It is used by pilgrims going to Kailash-Manasarovar. (Not Himachal with Ladakh)	**Hence, Pair 3 is incorrect.**
Bomdila pass	Arunachal Pradesh with Lhasa City (China). Not Arunachal Pradesh with Myanmar	**Hence, Pair 4 is incorrect.**

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9. Solution: (c)

Exp) Option c is the correct answer.

Satpura Range is part of the Deccan plateau. The hills stretch for some 560 miles (900 km) across the widest part of peninsular India, through Maharashtra and Madhya Pradesh. The range forms the watershed between the Narmada (north) and Tapti (south) rivers.

Option 1, 2 and 3 are correct. The Satpura Range includes the **Mahadeo** Hills to the north, the **Maikala** Range to the east, and the **Rajpipla** Hills to the west.

Although it is economically poor, the Satpura Range contains some worked manganese and coal deposits in its south-eastern flanks. It is largely forested, dissected plateau country, and it contains valuable teak stands in the west.

Option 4 is incorrect. The Rajmahal Hills are not part of Satpura range. Rajmahal hills forms the northeastern edge of the Chotanagpur Plateau. These hills are mostly made of basalt and are covered by lava flows {Basaltic Lava}. They run in north-south direction and rise to average elevation of 400 m (highest mount is 567 m). These hills have been dissected into separate plateaus.

10. Solution: (c)

Exp) Option c is the correct answer.

Duncan Passage is about 48 km wide passage which separates **South Andaman** (Rutland Island) in the north from **Little Andaman** in the south. Hence, option c is correct answer.

Important Tips

Duncan passage and Ten degree channel:

The Duncan passage is not similar to ten degree channel. Duncan passage separates two parts of the Andaman Island groups (South and Little Andaman), while the Ten degree channel separates the Andaman and the Nicobar groups.

11. Solution: (d)

Exp) Option d is the correct answer.

The Aravalli's are eroded stub old, folded mountain ranges stretched for a distance of 800 km. from Himmat nagar in Gujarat to Delhi, spanning Haryana, Rajasthan, Gujarat, and Delhi.

Statement a is incorrect. The **Block mountains**, also known as fault block mountains, are the result of faulting caused by tensile and compressive forces motored by endogenetic forces coming from within the earth

Statement b is incorrect. The **Geosynclines,** which are long narrow depressions of water are characterized by gradual sedimentation and generally bordered by two rigid masses which are called **forelands.**

Statement c is incorrect. The **Dome mountains** are originated by magnetic intrusions and up warping of the crustal surface Examples, normal domes, lava domes, batholithic domes, laccolithic domes, salt domes etc.

Statement d is correct. The Aravalli mountains are result of **denudation** and folding of crustal rocks by **compressive forces** generated by endogenetic forces coming from within the earth. They have now become **relict folded mountains.**

12. Solution: (d)

Exp) Option d is the correct answer.

Option 1 is incorrect: Barren Island is in the **Andaman and Nicobar islands.** It is India's only live volcano, erupting once again in 2017.

Option 2 is incorrect: Narcondam Island is classified as a dormant volcano by the Geological Survey of India. The Mountain house second tallest point in the **Andaman and Nicobar Islands.**

Option 3 is incorrect: Baratang Island lies 150 km from **Port Blair** in Andman Islands and has only mud volcano in India.

Option 4 is incorrect: Dhinodhar hills are located at the Kutch district of Gujarat.

13. Solution: (d)

Exp) Option d is the correct answer.

The Kashmir Himalayas are also famous for Karewa formations, which are useful for the cultivation of Zafran, a local variety of saffron.

Statement 1 is correct: Karewas are plateau like landform which are 13000-18000-metre-thick deposits of alluvial soils and sediments like sandstone and mudstone. These are found in Kashmir valley region, especially in the Pir Panjal range. The karewa sediments not only hold fossils and remnants of many human civilisations and habitations but are also the **most fertile spots** in the valley.

Statement 2 is correct: Karewas are very famous for the Zafran cultivation but are also very important for the cultivation of almonds, walnuts, apples and several other cash crops.

Statement 3 is correct: Karewas are formed by unconsolidated lacustrine deposits which are also known as lake deposits. In Pleistocene period, when the upliftment of the Pir Panjal ranges happened, the flow of the river had stopped. As a result, the whole of Kashmir valley became a large lake. Slowly, the glacial deposits have accumulated here in this lake. Thus, creating a large lacustrine plain. Later, the water drained away, and these unconsolidated deposits remained there. These unconsolidated gravel and mud deposits are known as Karewa formation.

14. Solution: (a)

Exp) Option a is the correct answer.

The region lying to the west of the Bangar region in the desert of Rajasthan is known as Rohi. It is a fertile floodplain formed by several small rivers or streams which rise in the Aravalli range and flow westwards through the desert region. The streams remain dry for most of the time in the year but get flooded during the rainy season. **The plain thus created by the flooding of these streams is known as Rohi.**

15. Solution: (c)

Exp) Option c is the correct answer.

On the basis of the location and active geomorphological processes, coastal plains can be broadly divided into two: (i) the western coastal plains; (ii) the eastern coastal plains.

Statement 1 is correct: The eastern coastal plain is broader and is an example of an *emergent coast*. There are well developed deltas here, formed by the rivers flowing eastward into the Bay of Bengal. Because of its emergent nature, it has a smaller number of ports and harbours.

Whereas the western coastal plains are an example of *submerged coastal plains*. It is believed that the city of Dwaraka which was once a part of the Indian mainland situated along the west coast is submerged under water. Because of this submergence it is a narrow belt and provides natural conditions for the development of ports and harbours. Kandla, Mazagaon, JLN port Navha Sheva, Marmagao, Mangalore, Cochin, etc. are some of the important natural ports located along the west coast. Extending from the Gujarat coast in the north to the Kerala coast in the south.

Statement 2 is correct: The rivers flowing through western coastal plain do not form any deltas as *slope of rivers is very steep*. The slope of the Western Ghats is steep and that is the reason that these rivers have a rapid flow. They don't have to travel much distance to drain into the sea. As a result, they don't carry much sediments required to form deltas.

Statement 3 is correct: The Malabar coast, which is a part of western coastal plains, has got certain distinguishing features in the form of **'Kayals' (backwaters),** which are used for fishing, inland navigation and also due to its special attraction for tourists. Every year the famous Nehru Trophy Vallamkali (boat race) is held in Punnamada Kayal in Kerala.

Statement 4 is incorrect: Estuaries are also found along the eastern coastal plains. For example - The Vellar estuary on the eastern coast of southern India (Tamil Nadu) and Hooghly River estuary. Western coastal plains also have estuaries. The Narmada, Periyar and Tapti are the. long rivers, which flow west and make estuaries along the western coastal plain. Estuaries ***and their surrounding wetlands are bodies of water usually found where rivers meet the sea***

16. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is correct: Lipu Lekh is a pass between Uttarakhand and Tibet Autonomous Region (TAR) of China. It is located at India, Nepal and Tibet (China) border trijunction at an elevation of 5000m. It is located in the Pithoragarh district of Uttarakhand. It is an ancient route that is used even today by pilgrims to visit Kailash Manasarovar located in the TAR. Hence this pairing is **correct.**

Pair 2 is incorrect: Rohtang Pass is a mountain pass situated in the state of Himachal Pradesh (3979m) and provides road link between Kullu and Lahaul & Spiti Valleys. It does not connect Himachal and Jammu-Kashmir. Hence this pairing is incorrect.

Bara La Cha is the pass situated in Himachal Pradesh which connects Jammu & Kashmir regions with the Himachal region.

Pair 3 is correct: Nathu La is a pass located on the Indo-China border near the strategically important Chumbi valley. It connects Sikkim to Tibet. Standing at a height of 4310m, it straddles the states of Sikkim and West Bengal. It has been a part of the ancient Silk Route path and is still used for inter border trade between India and China.

Pair 4 is incorrect: Khardung La at an elevation of 5602m is the highest motorable road in the world. It is located in the Leh district of Ladakh range and connects it to the Kashmir region. **Hence this pairing is incorrect.**

17. Solution: (d)

Exp) Option d is the correct answer.

The Great Indian Plains is one of the 5 main physiographic divisions of India. These Plains are subdivided into many regions/ divisions, each showing many depositional features which have their own terms/ names in local parlance such as Khadar, Bhangar, Bet, Bhur, Dhaya, etc.

Option a is incorrect: The Bhur refers to an elevated piece of land formed along the Ganga, especially in the upper Ganga-Yamuna Doab region (not Punjab Haryana region). Also, they are formed by aeolian (due to wind) deposits, not fluvial deposits. Hence this option is **incorrect.**

Option b is incorrect: The Cho refers to the numerous streams which create gully erosion in the plains near the Shivalik region. They are in fact not any sort of depositional feature. Hence this option is **incorrect.**

Option c is incorrect: The Reh refers to barren saline areas around Uttar Pradesh (not Punjab & Haryana). These are not formed due to or near fertile alluvial deposits as mentioned in the para. Hence this option is incorrect.

These are also known by the name **Kallar.**

Option d is correct: Dhaya is the local name given to bluffs (steep shorelines formed by fluvial deposition). They are formed adjoining the Khadar areas in the Punjab-Haryana Plains subdivision of the Great Plains physiographic division of India. They are as high as 3m and are marked by gully erosion due to the streams emanating from the river along which these are formed. Hence this option is **correct**

18. Solution: (d)

Exp) Option d is the correct answer.

The Archaean Rock System is the oldest in this group at 4000 MYA (Million Years Ago), followed by Dharwar system (3100 MYA), followed by the Cuddapah system (1400 MYA) followed by the Vindhyan system (1300 -600 MYA). Hence the correct order of oldest to newest rock systems is 3-1-2-4.

Option 3: The Archaean Rock system is the oldest rock system of Indian geological history. The Schists and Gneiss of this system are the oldest rocks of India and are referred to as the "Fundamental/ Basement complex". They were formed during the cooling and solidification of the earth's crust (4000 MYA). They are Azoic (having no trace of life or

organic remains), crystalline plutonic intrusions. Apart from the Peninsular block, they are found in Odisha, Meghalaya, Madhya Pradesh, Chhattisgarh and Chota Nagpur Plateau of Jharkhand. They are also found in the Bundelkhand region and in some areas around the Aravalli's. They are also found all along the Himalayas forming the bulk of high ranges and the backbone of the mountain system.

Option 1: Dharwar is a subseries of the Archean Rock system. The oldest of this subseries dates back to 3100 million years ago (MYA), and continues up to 1000 MYA. Most of these rocks are Metamorphic rocks of both sedimentary and igneous origin. It is found primarily in the Dharwar-Bellary-Mysore belt of Karnataka. These are believed to be the most ancient sedimentary metamorphic rocks of India, almost as old as basement gneiss and schists. The major rocks of this system are hornblende, schists, quartzites, slates, phyllites, crystalline limestones and dolomites.

Option 2: The Cuddapah Rock System is a subseries of the Purana Rock System. It dates back to almost 1400 MYA. It came after a significant gap after the Dharwar system. It contains many layers of Un fossiliferous clay, slates, quartzites, sandstones, and limestones. It is most widespread in the Cuddapah and Kurnool districts of Andhra Pradesh. It is also found in southern parts of Chhattisgarh such as Dantewada, Bastar, Raipur, Durg, etc. A few isolated occurrences are also seen in Singhbhum district of Jharkhand, Kalahandi & Keonjhar districts of Odisha and along the Aravalli axis. It is economically significant as it contains ores of iron, manganese, cobalt, nickel, copper, etc as well as cement grade limestone, etc.

Option 4: The Vindhyan Rock system is also a subseries of the Purana Rock System. It came after the Cuddapah series and is dated almost 1300 MYA. It comprises ancient sedimentary rocks lying over the Archaean system. It consists of stratified formations of sandstones, shales and limestones. These are found in vast stretches from Bihar to Rajasthan with a gap around the Bundelkhand region. It is also found in Chhattisgarh, Bhima valley in Karnataka and Kurnool district of Andhra Pradesh. It continues into the Gangetic region and is believed to have bucked under the Himalayan region during tectonic upheaval and subsequent Folding. These rocks have 2 types of deposits

- Lower Vindhyan: Marine origin, calcareous origin, Folding, older (1300-1100 MYA)
- Upper Vindhyan: Fluvial origin, newer (1000-600 MYA)

19. Solution: (b)

Exp) Option b is the correct answer.

The Western Coastal Plains are one of the 5 Physiographic divisions of India. It refers to the strip of land between the Western Ghats and the Arabian Sea. It is formed of various sediments ranging from salty ones to gravelly sandy beaches. It can be further subdivided into many divisions, each with its distinct characteristic features. These divisions are - The Kathiawar Plains, the Konkan Plains, the Karnataka Plains, and the Malabar Plains.

Pair 1 is correct: The Konkan is the division of the Western Coastal Plains between the river Narmada (south of the Gujarat/Kathiawar Plain) and the southern end of Goa. It runs for a length of about 500 km with its width varying between 50-80 km. **This region was formed as a result of submergence, hence there are many ports which have deep waters and are naturally suited to being harbours,** such as the JNPT port in Mumbai, etc. Hence this pairing is **correct.**

Pair 2 is correct: The Kathiawar Plains are the division of the Western Coastal Plains between the Kutch and the Konkan Plains (north of Narmada). Its highest point is Mount Girnar which is supposed to be a continuation of India's Peninsular block. Hence this region is believed to be of Volcanic origin like the rest of the Peninsular region. Hence this pairing is **correct.**

Pair 3 is incorrect: The Malabar is the division of the Western Coastal Plain between the Karnataka plains up to Kanyakumari. It is also known as Kerala Plains. This region is famous for its unique feature of lagoons called the backwaters/ Kayals. These are often formed as a result of depressions along coastlines wherein the ground level is lesser than the mean sea level, leading to incursion of brackish waters. Almost half of population in Malabar coast is engaged in agricultural activities. The fertile soil alluvial is useful for growing many crops in this region Hence this pairing is **incorrect.**

Pair 4 is incorrect: The Karnataka Plains (also known as Kannad/Kanara/Karavali plains), as the name suggests, is the division of the Western Coastal Plains between the Konkan Plains in the North and the Malabar Plains in the South, along the state of Karnataka. The Western Coastal Plains are broad at tips (both north and south), and at its narrowest in the middle. The average width of this division is a mere 30-50 km. **Thus, this division is the narrowest (not broadest) section of the Western Coastal Plains.** Hence this pairing is **incorrect.**

20. Solution: (d)

Exp) Option d is the correct answer.

The Satpura is a Hill Range in Central India and forms the northern border of the Deccan Plateau. It is bound by the Vindhya Range and River Narmada in the North and the River Tapi in the South. It runs in an east-west manner. Several protected areas have been earmarked in the area, including the Kanha, Pench, Gugamal and Satpura National Parks, Pachmarhi Biosphere Reserve, Melghat Tiger Reserve and the Bori Reserve Forest.

Statement 1 is incorrect: The Satpura range is an example of Block Mountains not the young fold mountains. Hence this statement is incorrect.

There are many ways by which a mountain may form - two main methods are by a) Folding b) Faulting. When due to tectonic pressures a Fault occurs, a block of earth is thrust upwards and is known as the Horst (mountain), while the other sides slip downwards and are known as Graben (valleys). The Satpura range is the Horst Mountain created

by upthrust when large-scale Faulting took place in this region. It is flanked by the Narmada and the Tapi Grabens on either side.

Statement 2 is incorrect: The Satpura Range is an example of Relict mountains. Relict mountains are very old mountains which have **become severely denuded and lost a lot of their height and continuity due to prolonged exposure to agents of weathering and erosion.** Today the Satpura range stands at an average elevation of 600-900m, which is very less compared to young mountains like the Himalayas with peaks standing 7000-8000 m tall. Thus, the Satpura range is termed Relict Mountain which reflects its old and denuded status. Hence this statement is **incorrect.**

Statement 3 is incorrect: The Satpura ranges are not very rich in the deposits of minerals. It contains small quantities of manganese and coal. Hence this statement is **incorrect.**

It is the eastern part of the Central Highlands that is geologically rich in minerals of commercial value.

21. Solution: (c)

Exp) Option c is the correct answer.

The correct order of peaks starting from east, and ending in west among given options is 3 (Nokrek) -> 1 (Kanchenjunga) -> 2 (Kamet) -> 4 (Nun-Kun).

Option 3: Mount Nokrek is the highest peak on the Garo Hills. It stands at a height of 1720m in the state of Meghalaya. The surrounding area is rich in biodiversity and has been declared a National Park as well. The mother germplasm of Citrus-indica has been discovered by science researchers within the Nokrek Range.

Option 1: Mount Kanchenjunga is a peak in the North Eastern section of the Greater Himalayas. At 8586m, it is the 3rd highest mountain peak in the world. It lies along the border of Nepal and India (in the state of Sikkim). It has also been designated a National Park and was declared to be a UNESCO World Heritage Site in 2016. It is bound by the river Teesta to the east.

Option 2: Mount Kamet is a peak in the western section of the Greater Himalayas. It is located in the Garhwal region of the state of Uttarakhand and stands at a height of 7756. It lies immediately to the west of Nanda Devi Peak (highest in the Garhwal region).

Option 4: Nun Kun is a mountain massif of the greater Himalayan range, located on the border of Jammu and Kashmir and Ladakh in northern India. It consists of two main peaks: Nun and Kun, separated from each other by a 4 km long snowy plateau, with a third peak of the massif, known as Pinnacle Peak, lying at its eastern end.

22. Solution: (d)

Exp) Option d is the correct answer.

The great plains of North India are considered monotonous and characterized by its extreme horizontality and low elevation that exhibits distinctive fluvial patterns, directions of flow, and geomorphology. It is divided into the following four regions: The Rajasthan Plain; the Punjab–Haryana Plain; the Ganga Plain and the Brahmaputra Plain.

Option d is correct. In the Thar Desert, the shifting sand dunes are locally known as Dhrian. The Indian desert or the thar desert accounts for a greater part of the Marwar plain of Rajasthan is called Marusthali. The eastern part of the Thar Desert near the Aravali Range is a semi-arid plain which is known as the Rajasthan Bagar. In general, the eastern part of the Marusthali is rocky while its **western part** is covered by **shifting sand dunes** locally known as **Dhrian.**

23. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct. A rift valley is a **lowland region that forms where Earth's tectonic plates move apart, or rift.** Rift valleys differ from river valleys and glacial valleys in that they are created by tectonic activity and not the process of erosion.

Statement 2 is correct. Rift valleys are **found both on land and at the bottom of the ocean**, where they are created by the process of seafloor spreading. **Many of Earth's deepest rift valleys are found underwater,** dividing long mountain ranges called mid-ocean ridges. As tectonic plates move away from one another at mid-ocean ridges, molten rock from the mantle may well up and harden as it contacts the frigid sea, forming new oceanic crust at the bottom of the rift valley.

Statement 3 is incorrect. The **Narmada and the Tapi** are the rivers which flow through a rift valley. The Damodar River also flows through a rift valley.

24. Solution: (c)

Exp) Option c is the correct answer.

The Dooars or Duars are the **alluvial floodplains** at the foothills of the eastern Himalayas in North-East India. The Dooars valley (also called Duars) stretches from River Teesta on the west to River Sankosh on the east, an area covering roughly 130 km by 40 km that forms the gateway to Bhutan from India. The doors are bifurcated into two regions- **Western Dooars** is known as the Bengal Dooars and the **Eastern Dooars** as the Assam Dooars. The Eastern Duars, in western Assam state, comprises a level plain intersected by numerous rivers and only slightly populated. The Western Duars lies in northern West Bengal state and is a portion of the Tarai, a lowland belt linking the Himalayas and the plains region.

25. Solution: (d)

Exp) Option d is the correct answer.

Andaman and Nicobar Islands, considered a union territory in India, consists of two groups of islands. The islands located north of 10° north latitude are known as Andaman Islands while the islands located south of 10° north latitude are called Nicobar.

Statement 1 is correct. The Andaman–Nicobar Islands is the emergent part of a long ridge which extends from the **Arakan–Yoma ranges** of western Myanmar (Burma) in the north to **Sumatra in the south.** The arc constitutes the boundary between the Bay of Bengal to the west and the Andaman Sea to the east.

Statement 2 is incorrect. The Andaman and Nicobar Islands are not of coral origin, unlike the Lakshadweep. The Andaman & Nicobar Islands is formed by sandstone, limestone, and rocks of **Cenozoic era** (Neogene and Paleogene age i.e., some 2.6 to 65 million years old). This makes the terrain of Andamans & Nicobar rough, with hills enclosing narrow longitudinal valleys.

Statement 3 is correct. According to the Forest Survey report 2021, the total mangrove cover in the country is 4,992 sq. km. Out of this, **615 sq.km, area** is mangrove vegetation occur in Andaman & Nicobar Islands. In the **Andaman group of islands** alone, area under mangroves is **612 sq.km,** while in **Nicobar group of island** mangroves occupy **only 3 sq. km.**

Statement 4 is correct. Ritchie's Archipelago is an island of the Andaman Islands. It is a cluster of smaller islands which lie 20 km east of **Great Andaman,** the main island group of the Andaman Islands. It comprises some 4 larger islands, 7 smaller islands and several islets, extending in a roughly north-south chain, parallel to the **main Great Andaman group.**

26. Solution: (a)

Exp) Option a is the correct answer.

Assertion (A) is correct: The Tropic of Cancer passes almost halfway through India. So, the part below the Tropic of Cancer falls within the Torrid zone and exhibits Tropical climate.

However, the upper half of the country which lies in the Temperate Zone, also does not exhibit the kind of extremes of climate expected in such areas. Most of India has a Hot and Humid Climate characteristic of Tropical climate despite being only half of its territory being in the tropical zone. **Hence the Assertion is correct.**

Reason (R) is correct: The Himalayas separate the Indian subcontinent from the rest of Asia by acting as a huge physical barrier. It prevents the moisture laden monsoon winds from escaping onto Tibet, forcing these winds to shed their moisture in India's Plains. Likewise, during winter, it prevents the extremely cold winds coming from Siberia and China from entering North India, thereby preventing extremely cold winters. Hence the Himalayas act as a climate barrier. So, the Reason is also a correct statement.

Since the Himalayas prevent the climate of Northern half of India from becoming very extreme and stops the monsoon winds which keeps the climate hot and humid, the Reason is the correct explanation of the Assertion.

27. Solution: (c)

Exp) Option c is the correct answer.

The Arunachal Himalayas extend from the east of the Bhutan Himalayas up to the Diphu pass in the east. The general direction of the mountain range is from southwest to northeast (not from north to south).

Statement 1 is correct: Some of the important mountain peaks of the Arunachal Himalayas are Kangto and Namcha Barwa.

Statement 2 is correct: An important aspect of the Arunachal Himalayas is the numerous ethnic tribal communities inhabiting these areas. **Some of the prominent ones from west to east are the Monpa, Abor, Mishmi, Nyishi and the Nagas.** Most of these tribes practise Jhumming (a type of cultivation/agriculture). It is also known as shifting or slash and burn cultivation. This region is rich in biodiversity which has been preserved by the indigenous communities.

28. Solution: (c)

Exp) Option c is the correct answer.

Option 1, 2, 3 and 5 are correct: The four states that share a boundary with Telangana are:

Chhattisgarh (north)

Andhra Pradesh (south and east)

Karnataka (west)

Maharashtra (north-west)

Option 4 is incorrect: Madhya Pradesh do not share boundary with the state of Telangana.

29. Solution: (d)

Exp) Option d is the correct answer.

A fault is a fracture or zone of fractures between two blocks of rock. Faults allow the blocks to move relative to each other.

The Dauki fault (and not malda fault) is a major fault along the southern boundary of the Shillong plateau that may be a source of destructive seismic hazards for the adjoining areas, including northeastern Bangladesh.

Important Tips

The Karbi Anglong and the Meghalaya Plateau in the northeast and Rajasthan in the west are also extensions of Indian peninsular block. The northeastern parts are separated by the Malda fault in West Bengal from the Chotanagpur plateau.

The Peninsular plateau has been separated from the peninsular block by a wide gap known as the Garo-Rajmahal Gap (Malda Gap). The down-thrusting of the Malda gap area between the Rajmahal hills and the Meghalaya plateau during the mid-pleistocene period, diverted the Ganga and the Brahmaputra systems to flow towards the Bay of Bengal.

Malda gap was later filled by sediment deposits of the Ganga and its tributaries. The plateau is largely formed by Archaean quartzites, shales and schists with granite intrusions and some basic silts similar to the peninsular region.

30. Solution: (a)

Exp) Option a is the correct answer.

Standard Meridian is the longitude or the meridian which is used for determining standard time of a country.

Statement I is correct: The standard meridian of India is the longitude that is used to calculate the Indian Standard Time (IST). 82°30' East longitude has been selected as the

Standard Meridian for India. It passes through the city of Mirzapur in Uttar Pradesh.

Statement II is correct and is the correct explanation for Statement-I: The longitude of 82°30'E **passing through Mirzapur** was chosen as the standard meridian for the whole country **because it is in the middle of the eastern and western longitudinal extremes of India.** The adoption of this specific longitude as the Standard Time Meridian allowed for the implementation of a unified time standard across India.

31. Solution: (b)

Exp) Option b is the correct answer.

The Indian states that share a land border with Bangladesh are **Assam, West Bengal, Mizoram, Meghalaya, and Tripura.**

Option 1 is incorrect: Sikkim does not share a direct land border with Bangladesh. It is situated in the northeastern part of India but does not share a boundary with Bangladesh.

Option 2 is correct: Mizoram shares a border with Bangladesh. It is a northeastern state of India that shares a boundary with both Myanmar and Bangladesh.

Option 3 is correct: Assam, a state in northeastern India, shares a border with Bangladesh. It forms a significant part of the India-Bangladesh border in the northeast.

Option 4 is correct: Meghalaya shares a border with Bangladesh. It is a northeastern state of India that shares a boundary with Bangladesh on its southern side.

Option 5 is incorrect: Nagaland does not share a direct land border with Bangladesh. It is located in the northeastern part of India but does not share a boundary with Bangladesh.

32. Solution: (d)

Exp) Option d is the correct answer.

Bhabar or Bhabhar is a region located south of the Lower Himalayas and the Shivalik Hills in Kumaon, India. It is a belt of 8-16 km lying parallel to the slopes of the Shivalik, where the rivers descending from the mountains deposit pebbles. The **streams flow through the pebbles in the region, hence disappearing from sight.** They re-emerge only after some distance south, in the relief feature Terai. It is **relatively less fertile compared to the adjacent plains.** The name Bhabar refers to a local tall-growing grass, Eulaliopsis binata, used for the manufacture of paper and ropes. The Bhabar region contains some of the largest cities of Kumaon and Garhwal: Haldwani, Ramnagar, Tanakpur, and Kotdwar.

Important Tips

1) **Khadar** is the newer and fertile alluvial soil that is deposited by rivers during their periodic flooding. These deposits are rich in nutrients, making Khadar areas highly fertile and suitable for agriculture. Khadar regions are located adjacent to rivers and are renewed with fresh sediments during floods.
2) **Bhangar** comprises the older alluvial deposits found above the floodplains. These deposits are comparatively higher in elevation and are older than the Khadar. Bhangar areas are less fertile due to a lower nutrient content compared to the Khadar. They are mainly used for rain-fed agriculture and are located further away from the river channels.
3) **Tarai:** South of the Bhabar is the Tarai belt, with an approximate width of 10-20 km where most of the streams and rivers re-emerge without having any properly demarcated channel, thereby, creating marshy and swampy conditions known as the Tarai. This has a luxurious growth of natural vegetation and houses a varied wildlife.

33. Solution: (d)

Exp) Option d is the correct answer.

The Western Ghats and the Eastern Ghats are two mountain ranges that run parallel to the western and eastern coasts of India, respectively.

Statement 1 is incorrect: The Western Ghats are **continuous and are higher in elevation than the Eastern Ghats.** The average elevation of the Western Ghats is 900–1600 meters, while the Eastern Ghats average 600 meters.

Statement 2 is incorrect: The highest peak of the Western Ghats is **Anamudi at 2,695 meters** (8,842 feet) located in the Indian state of Kerala. Kalsubai is the highest peak (1646 meters) in Maharashtra, India. It is also part of the Western Ghats Mountain range.

Statement 3 is correct: The Western Ghats form one of the four watersheds of India, feeding the perennial rivers of India. The **major river systems originating in the Western Ghats are the Godavari, Kaveri, Krishna, Thamirabarani, and Tungabhadra rivers.**

1) **The Thamirabarani or Tamraparni or Porunai is a perennial river that originates from the Agastyarkoodam peak of Pothigai hills of the Western Ghats.** It flows through Tamil Nadu state of southern India into the Gulf of Mannar.
2) **The Tungabhadra River originates in the Western Ghats, a mountain range that runs along the western coast of India.** The river has two main tributaries, the Tunga River and the Bhadra river. The Tunga River originates in the Chikmagalur district of Karnataka and the Bhadra river originates in the Western Ghats of the Shimoga district of Karnataka. The two rivers meet near Kudli, in the Shimoga district, to form the Tunga Bhadra River.

34. Solution: (b)

Exp) Option b is the correct answer.

The Meghalayan plateau, situated in the northeastern region of India, is known for its unique geographical features, high rainfall, and diverse mineral resources.

Statement 1 is correct: The Meghalayan plateau is an **extension of the Indian peninsular plateau** and was

originally divided into two plateaus: the Karbi Anglong Plateau and the Meghalaya Plateau.

Statement 2 is incorrect: The Meghalaya plateau is rich in minerals such as **coal, limestone, kaolin clay, granite, glass-sand, and uranium.** However, it is not known for fossil fuels such as natural gas and crude oil.

Statement 3 is correct: Meghalaya Plateau area receives maximum rainfall from the southwest monsoon. As a result, the Meghalaya plateau has a highly eroded surface. Cherrapunji displays a bare rocky surface devoid of any permanent vegetation cover.

35. Solution: (c)

Exp) Option c is the correct answer.

The coastline of India is about 7517 Km long (6100 km of mainland coastline and around 1417 km of Indian islands). 13 States and UTs have coastal plains in India. The Coastal States of India are Kerala, Tamil Nadu, Gujarat, West Bengal, Goa, Karnataka, Maharashtra, Andhra Pradesh, and Odisha. Daman & Diu, Puducherry, Lakshadweep Islands, and Andaman & Nicobar Islands are the coastal Union territories. The top 3 Indian States having the longest coastline:

1. Gujarat – 1215 Km,
2. Andhra Pradesh – 974Km,
3. Tamil Nadu – 907 Km.

Statement 1 is correct: The western coastal plain of India **is a submerging coast, while the Eastern coastal plain of India is an emergent coast.** The Western coastal plain submerges because the landmass dips along a fault line, sinking the coast.

Statement 2 is incorrect: The width of the continental shelf varies greatly ranging between a few kilometers to more than 100 kilometers. This variation can be seen even in the context of Indian peninsula. The **continental shelf off the eastern coastal plain of India is almost twice more than that of the western coastal plain of India.**

Statement 3 is correct: The Western coastal plain of India is more suitable for ports compared to the Eastern coastal plain. The continental shelf of Eastern coastal plains extends up to 500 km into the sea, which makes it difficult for the development of good ports and harbours. The western coastal plain, being a submergent coast, is a narrow belt and provides natural conditions for ports and harbours.

Statement 4 is correct: The Western coastal plain of India is characterized by a rocky coastline and is narrower than the Eastern coastal plain. The Western coastal plain is also home to short and fast-flowing rivers, which do not result in delta formation. In contrast, the Eastern coastal plain of India is broader and has a gentler slope. The east-flowing rivers on the Eastern coast flow with low velocities and deposit the sediments brought with them at the coast, resulting in the formation of deltas. Therefore, the **Eastern coastal plain of India has more extensive deltas compared to the Western coastal plain of India.**

36. Solution: (b)

Exp) Option b is the correct answer.

The **Ten Degree Channel** is a channel that separates the **Andaman Islands and Nicobar Islands from each other in the Bay of Bengal.** It is approximately 150 km wide from north to south and 10 km long from east to west. The channel is named so because it lies on the 10-degree line of Latitude, north of the equator.

Important Tips

1) The Minicoy Island and Maldives are separated by the Eight Degree Channel
2) The Nine Degree Channel is a channel in the Indian Ocean between the Laccadive Islands of Kalpeni and Suheli Par, and Maliku Atoll (Minicoy Island).

37. Solution: (d)

Exp) Option d is the correct answer.

The erosional activity varies between the Western and Eastern coasts of India due to differing geological features, climate patterns, and coastal dynamics.

Statement-I is *incorrect*: While the **erosional activities dominate the west coast, depositional activities dominate the east coast of India.** The western coasts of India, along the Arabian Sea, experience significant erosional activity due to the impact of strong waves. Conversely, the **Eastern coasts of India, along the Bay of Bengal, are characterized by substantial depositional activities caused by east flowing rivers.**

Statement-II is correct: Numerous significant rivers like the **Ganges, Brahmaputra, and Godavari flow eastward,** emptying into the Bay of Bengal along the Eastern coast. These rivers transport **substantial sediment loads, forming deltas** along the Eastern coast, thereby establishing **depositional activity a dominant feature.**

38. Solution: (d)

Exp) Option d is the correct answer.

The Aravalli Range is a mountain range in northwest India that runs for about 670 kilometers from Delhi to Ahmedabad. It's one of the oldest mountain ranges in India and is also known as the Mewat Hills.

Statement 1 is incorrect: While the Aravalli Range is one of the oldest mountain ranges in the world, it is **not classified as a block mountain.** It is primarily a result of ancient tectonic activity and is **considered one of the oldest fold mountain ranges.**

Statement 2 is correct: The Aravalli range is made up of metamorphic and igneous rocks, including amphibolite, tonalitic gneisses, and intrusive granitoids. The Aravalli Mountain ranges in Rajasthan contain rich reserves of minerals, including **Copper, Lead, Zinc, Rock phosphate, Soapstone, Silica sand, Limestone, Marble, Gypsum.**

Statement 3 is correct: The Aravalli Range is a source of many rivers, such as the **Banas, the Luni, the Sakhi and the Sabarmati.**

Statement 4 is correct: The Aravalli Range acts as a **barrier between the Thar Desert and the Gangetic Plains,**

preventing additional desertification in Rajasthan's eastern parts, and afterwards in the Gangetic plains.

39. Solution: (b)

Exp) Option b is the correct answer.

The Peninsular Plateau of India, the oldest and most stable landmass of the Indian subcontinent, rises from approximately 150 meters above the river plains to elevations ranging from 600 to 900 meters. This irregular triangle-shaped plateau is defined by various geographical features: the Delhi Ridge in the northwest (an extension of the Aravalli Range), the Raajmahal Hills in the east, the Gir Range in the west, and the Cardamom Hills in the south.

Statement 1 is correct: Coal is the main source of energy in India as it fulfils almost 67 per cent of the total commercial energy consumed in the country. This fossil fuel is found in a form of sedimentary rocks and is often known as 'Black Gold'. **About 98% of the Gondwana coal deposits are found in the Peninsular plateau. Some of the important Gondwana coal reserves include Talcher field(Odisha), Singrauli coalfield (Madhya Pradesh),Singareni (Andra Pradesh) etc.**

Statement 2 is correct: The plateau provides suitable conditions for cotton cultivation due to its black soil and warm climate. **A large part of the Northwest plateau is covered with fertile black lava soils which is extremely useful for growing cotton.** Major cotton-producing states like Maharashtra, Telangana, and Andhra Pradesh are located in this region.

Statement 3 is incorrect: Not all rivers originating from the Peninsular plateau are draining into the Bay of Bengal. While some major rivers like **Godavari, Krishna, and Cauvery flow eastward and drain into the Bay of Bengal, others like Narmada and Tapti flow westward and drain into the Arabian Sea.**

Statement 4 is incorrect: The Peninsular plateau is rich in mineral deposits such as iron, manganese, copper, bauxite, chromium, mica and gold. **Tummalapalle Mine in Kadapa (Cuddupah) district of Andhra Pradesh is home to India's largest uranium reserves.** Further, the **Meghalaya plateau, which is also the part of Peninsular plateau, is rich in mineral resources like coal, iron ore, sillimanite, limestone and Uranium.**

40. Solution: (d)

Exp) Option d is the correct answer.

The Eastern Ghats comprising the discontinuous and low hills (compared to the Western Ghats) are highly eroded by the rivers such as the Mahanadi, the Godavari, the Krishna, the Kaveri. They run from the **northern Odisha through Andhra Pradesh to Tamil Nadu in the south passing some parts of Karnataka.**

Statement 1 is incorrect: The highest peak in the Eastern Ghats is Jindhagada Peak. It has an elevation of 1,690 metres. It is located in the **Araku Valley of Andhra Pradesh** (not Odisha). Some of the other important ranges of the Eastern Ghats include the Javadi hills, the Palconda range, the Nallamala hills, the Mahendragiri hills, etc.

Statement 2 is incorrect:

1) **The Brahmani, known as the South Koel River** in the upper reaches, originates near Nagri village in Ranchi (Chota Nagpur Plateau) **district of Jharkhand at an elevation of about 600m.**
2) **The Subarnarekha** originates near **Nagri village in Ranchi district of Jharkhand at an elevation of 600 m.**
3) Hence, they did not originate in the eastern Ghats.

41. Solution: (a)

Exp) Option a is the correct answer.

The Deccan Traps in India, now dominating the Maharashtra plateau, represent a vast flood basalt region. Lava flowing through cracks and fissures in the land solidifies vertically, forming wall-like structures known as dykes. These dykes, prevalent in western Maharashtra, are believed to have supplied lava for the eruptions that created the Deccan Traps.

Statement 1 is correct: India was once a sizable island located off the coast of Australia, separated from the Asian continent by the Tethys Sea until approximately 225 million years ago. During the movement of the Indian plate towards the Asiatic plate it passed over the Reunion hotspot (which is today the Reunion Island) which led to outpouring of lava and resultant formation of the Deccan Traps. This started somewhere around 60 million years ago and continued for a long period of time, forming Deccan Traps.

Statement 2 is incorrect: Deccan traps extend to cover parts of Maharashtra, Madhya Pradesh, Chhattisgarh, Andhra Pradesh, Telangana, Karnataka, Gujarat, Rajasthan, Goa and Daman and Diu in peninsular India. Hence deccan traps are not confined solely to the States of Maharashtra and Gujarat.

Statement 3 is incorrect: Ferruginous lateritic ores are situated atop hills as laterite caps across various locations within the Deccan Traps. **Their iron content is relatively low, usually falling between 25 to 30%, which is notably less than the iron content found in hematite ore, which is usually around 70%.** Presently, these ores are not actively exploited, though they may hold potential for future utilization.

Important Tips

Black soil in India is formed by the weathering of fissure volcanic rock. Black soils are predominantly distributed across the interior regions of Gujarat, Maharashtra, Karnataka, and Madhya Pradesh, notably on the Deccan lava plateau and the Malwa Plateau, promoting cotton cultivation these areas.

42. Solution: (c)

Exp) Option c is the correct answer.

1-4-3-2 is the correct order of given hills from South to North direction.

The Himalayas, a lofty mountain forming India's northern borders extends from the Indus to the Brahmaputra in a

west-east direction. This majestic mountain range, spanning about 2,400 Km, varies in width from **400 Km in Kashmir to 150 Km in Arunachal Pradesh.** The **Brahmaputra** marks its **eastern boundary**, where it sharply **bends southward beyond the Dihang gorge, forming the Purvanchal** or Eastern hills and mountains along India's eastern edge.

Option 1: The Eastern Himalayas (also known as Purvanchal Himalayas) comprises the Patkai hills, the Naga hills, the Manipur hills and the Mizo hills. The Mizo hills is located in the State of Mizoram, thus making it the southernmost hills.

Option 4: The Barail Hills stand as the tallest hill range within Assam, encompassing the North Cachar Hill Reserve Forest (RF) of Cachar district, Barail RF of Cachar and North Cachar Hills districts. This **hill is located to the south of the Mikir Hills,** the Barail Range serves as the watershed between the Brahmaputra and Barak rivers. The terrain varies from flat and gently rolling in the river valleys to rugged and mountainous with steep slopes.

Option 3: The Mikir hills are located in Karbi Anglong District of Assam. Mikir tribes also known as Karbis are recognized as one of the prominent indigenous ethnic tribes in Northeast India, particularly inhabiting this hill. Note; it is not a part of Himalayas, but it is part of meghalaya plateau an extension of peninsula plateau.

Option 2: The Mishmi Hills, situated at the northeastern tip of India within central Arunachal Pradesh. With an altitude recorded at **5140 ft, they encompass both the Dibang Valley and Lower Dibang Valley districts of Arunachal Pradesh**. Temperatures in the region vary from below 5°C in winter to 38°C in summer. The Mishmi Hills area can be categorized into two main sections namely the flood plains of the Brahmaputra River tributaries, and the Arunachal Himalayas.

43. Solution: (b)

Exp) Option b is the correct answer.

The coastal plains in India run parallel to the Arabian Sea & Bay of Bengal along the Peninsular Plateau. The western coastal plain, bordering the Arabian Sea, is a narrow strip approximately 10-20 km wide, spanning from the Rann of Kachchh to Kanyakumari. In contrast, the eastern coast, along the Bay of Bengal, is broader than the western coastal plain.

Statement 1 is correct: The Western Coastal Plains exemplify a **submerged coastal plain**, illustrated by the submergence of ancient cities like Dwaraka. In contrast to the Western Coastal Plain, the Eastern Coastal Plain constitutes an emergent coast.

Statement 2 is correct: The peninsular rivers flowing into the Western coasts do not create extensive deltas. This is because of the **steep slopes of the Western Ghats,** which cause these rivers to flow rapidly with a steep gradient. Western Ghats runs parallel to the western coast for about 1600 km and the average elevation of the Western Ghats is 1000 meters. For example, Periyar, Netravati, Sharavathi.

On the other hand, **peninsular rivers flowing eastward into the Bay of Bengal, like the Mahanadi, Godavari, Krishna, and Kaveri rivers,** have formed **extensive deltas** due to their comparatively gentler gradients and the deposition of sediment as they enter the sea.

Statement 3 is incorrect: The submergence of western coasts results in a narrow belt conducive to the natural development of ports and harbors. Notable ports along this coast include Kandla, Mazagaon, JLN Port Navha Sheva, Marmagao, Mangalore, and Cochin.

On the other hand, due to the **emergent nature of the Eastern Coast,** it has fewer ports and harbors. Additionally, the continental shelf extends up to 500 km into the sea, **posing challenges for port development.** Ports on the eastern coast include Chennai, Visakhapatnam, Paradip, and Kolkata.

44. Solution: (a)

Exp) Option a is the correct answer.

In the Kashmiri dialect, the **term "Karewa" translates to "elevated tableland."** Coined by Godwin-Austin in 1859, it refers to an unconsolidated to semi-consolidated sand-clay-conglomerate sequence. These sedimentary formations manifest as terraces, plateaus, and mounds, overlaying the Paleozoic-Mesozoic sediments of the Kashmir basin.

Statement 1 is correct: Karewas are geological formations found in the Kashmir Valley, characterized by flat-topped hills or plateaus composed of unconsolidated and semi consolidated lacustrine deposits. These deposits were formed during the Pleistocene epoch when the Pir Panjal range, a mountain range in the region, acted as a barrier, blocking the natural drainage of the area. As a result, the water from the surrounding rivers and streams accumulated behind the range, forming a lake. Over time, sedimentation occurred within this lake, resulting in the deposition of fine-grained materials such as silt, clay, and sand. These sediments eventually solidified into the flat-topped hills known as Karewas, which are now an integral part of the landscape in Kashmir.

Statement 2 is incorrect: Karewas are found only in the Union territory of Jammu and Kashmir, particularly in the Kashmir Valley. While there may be similar geological formations in other regions, the term "Karewa" specifically refers to the elevated plateaus and terraces in the Kashmir region. The Karewas occupies an area of around 2500 sq km, and rests over the folded Paleozoic-Mesozoic rocks of the Kashmir basin. Most of the cultivated fields in the Kashmir valley are situated on the Karewa sediments.

Statement 3 is incorrect: Karewas are known for their rich deposits of fossils. These fossils, which include plant and animal remains, provide valuable insights into the region's past flora, fauna, and environmental conditions. Therefore, Karewas are not generally devoid of fossils, but rather contain significant paleontological evidence.

Important Tips

Importance of Karewas for the Kashmir region:

Karewas are composed of rich, fertile soil ideal for diverse crops. They are renowned for supporting the cultivation of **Kashmiri saffron** -A globally recognized spice, highly valued for its quality and economic contribution. It got a Geographical indication tag in 2020. Karewas act as natural water filters, and also contribute to the region's ecological balance.

~ Threats faced by Karewas:

Rapid expansion of cities and infrastructure devours these lands for construction.

Brick kilns and sand extraction activities ruthlessly exploit the Karewas due to their soil thickness.

45. Solution: (c)

Exp) Option c is the correct answer.

The Himalayan region is characterized by several major fault lines due to the ongoing tectonic activity associated with the collision of the Indian plate with the Eurasian plate. These faults in the Himalayas, namely Main Boundary Thrust (MBT), Main Central Thrust (MCT) and the Himalayan Frontal Thrust (HFT), run along the Himalayan Ranges.

A new fault is formed when the stress on the rock is great enough to cause a fracture, and one wall in the fracture moves relative to the other.

Option a is incorrect: The fault line which marks the boundary between the Lesser Himalayas and the Siwalik Range is called the **Main Boundary thrust (MBT)**. The MBT is another important fault line in the Himalayas. Similar to the Main Central Thrust(MCT), the MBT is also a thrust fault formed as a result of the tectonic compression between the Indian and Eurasian plates.

Option b is incorrect: The fault line between the Greater and the lesser Himalayas is called The Main Central Thrust. It is a significant geological fault in the Himalayas. It runs parallel to the Himalayan Mountain range, separating the Lesser Himalayas to the south from the Greater Himalayas to the north. This fault plays a crucial role in the tectonic processes associated with the ongoing collision between the Indian plate and the Eurasian plate.

Option c is the correct answer: The **Main Frontal Thrust (MFT), also known as the Main Himalayan Frontal Thrust, is a major geological fault that separates the Siwalik Range from the Indo-Gangetic Plains.** This thrust fault is responsible for the uplift of the Himalayan foothills and the formation of the Siwalik Range. The MFT is associated with significant seismic activity and has been responsible for several devastating earthquakes in the region.

Option d is incorrect: The South Tibetan Detachment System is a large-scale detachment fault that separates the Greater Himalayas from the Tibetan Plateau.

It is characterized by rocks on the upper plate (Tibetan Plateau) moving over rocks on the lower plate (Greater Himalayas).

46. Solution: (b)

Exp) Option b is the correct answer.

Lakshadweep is a group of 36 islands. The name Lakshadweep in Malayalam and Sanskrit means "a hundred thousand islands". It encompasses atolls, reefs, submerged banks and around ten uninhabited islands. Entry to Lakshadweep islands is restricted and an entry permit is needed to visit the islands of Lakshadweep.

Statement 1 is correct: Lakshadweep is the smallest Union Territory of India in terms of its geographical area. It is uni-district Union Territory with a total area of 32 sq. km. Jammu and Kashmir is the largest Union Territory in India with an area of 125,535 sq. km. followed by Ladakh (96,701 sq. km.) and Andaman and the Nicobar (8,249 sq. km.).

Statement 2 is incorrect: Kavaratti is the capital of Lakshadweep, but it is not the largest island. The **Andrott island is the largest of all the Lakshadweep's islands.** It is the only island having a very small lagoon area. Andrott is also the nearest island to the mainland. It has an east-west orientation unlike other islands lying in the north-south direction

Statement 3 is correct: The Minicoy Island is the southern-most island of Lakshadweep. It is also the **second largest island of Lakshadweep.** Minicoy is set apart from the Northern group of islands by its culture. The closest land to Minicoy is Thuraakunu Island in the Republic of the Maldives about 100 km to the south across the Vangaaru Channel. It is home to the only population in India who speak the Mahal language.

Statement 4 is incorrect: The Lakshadweep islands are separated from the Maldives by the **Eight Degree Channel,** not the Ten Degree Channel. In other words, the Minicoy island is separated from Maldives by the Eight Degree Channel. **The Ten Degree Channel separates the Andaman Islands and the Nicobar Islands**

47. Solution: (c)

Exp) Option c is the correct answer.

Coastal plains represent a **narrow strip between the edges of Peninsular plateau and the coastline** of India. The area between Western Ghats and the Arabian Sea coast is called as **Western Coastal plains** and the area between Eastern Ghats and Bay of Bengal coast is called as **Eastern Coast.**

The Utkal plains lie on the Eastern Coastal Plains. It comprises the coastal regions of **Odisha** and is about 400 kms long. **Mahanadi Delta** is located in this region. The Utkal plains are known for having **thick alluvium** from **Paleogene and Neogene age** (from about 65 to 2.6 million years ago). The region also encompasses **Archean gneiss and sandstone** (from about 4 billion to 2.5 billion years ago). **Chilika lake is India's largest saltwater lake** that lies in this region. Apart from this, **Samang and Sur are the freshwater lakes** found in this region. The **Mahanadi, Brahmani, Baitarani, and Subarnarekha rivers** flow through this region. **Bhitarkanika ,India's second richest mangrove region, located in the delta of the Baitarani, Brahmini and Mahanadi rivers.**

Utkal plains has **fertile red and black soils. Agriculture is the main occupation** in this region and **rice is the principal crop,** in addition to pulses and oilseeds.

48. Solution: (a)

Exp) Option a is the correct answer.

Didwana, pachpandra, and Khatu are salt lakes located in Rajasthan.

The Didwana lake is **located in the Nagaur district of Rajasthan**. The Didwana lake is around 4 km long and 3 km wide and surrounded with hills on all sides, except west. Its **bed possesses black clay,** and this lake also resembles Sambhar Lake.

The Pachpadra is another Salt Lake located in the Barmer district of Rajasthan. The lake has a sodium chloride level of around 98% and it produces high quality salt.

Khatu is another saltwater lake in Rajasthan, a Playa Lake (small lakes with flat floors and undrained basins where water collects after rains and evaporates quickly are called playas.)

Important Tips

The Sambhar Salt Lake, India's largest inland Salt Lake, is in Sambhar Lake Town, Jaipur district of Rajasthan, India. Kuchaman ,Tal Chappar, Lunnkaransar and Sargol are another important salt lakes of Rajasthan.

49. Solution: (a)

Exp) Option a is the correct answer.

Kallar, Dhrians and Bugyals are some of the local landforms found in India.

Pair 1 is incorrectly matched: Kallar or Reh is a term for the **saline and alkaline efflorescence (deposit of salts) that occurs in some parts of the Bhangar, the older alluvium of the** Indo-Gangetic-Brahmaputra Plain. It is caused by the capillary action of groundwater that brings salt to the surface.

Pair 2 is correctly matched: Dhrians are the **local name for the shifting sand dunes i**n the Thar Desert. The eastern part of Marushthali is rocky, while the western part is covered by shifting sand dunes.

Pair 3 is correctly matched: Bugyals are alpine pasture lands, or meadows, in higher elevation range between 3,300 metres and 4,000 metres of the Himalayas in the Indian state of Uttarakhand, where they are called "nature's own gardens"

50. Solution: (b)

Exp) Option b is the correct answer.

The correct order of the glaciers from east to west is 3-4-1-2.

3) **Zemu Glacier** is the **largest glacier in the Eastern Himalaya**. It is about 26 kilometres (16 mi) in length and is located at the base **of Kangchenjunga in the Himalayan region of Sikkim**, India. The Zemu Glacier drains the east side of Kanchenjunga, the world's third highest mountain.

4) **Gangotri Glacier** is one of the largest glaciers in the Himalayas and is the primary source of Ganges, the largest river in India. It is in the Uttarkashi district of Uttarakhand. This glacier originates at the northern slope of Chaukhamba range of peaks. This glacier serves as a vital source of the Ganga River.

1) **Siachen Glacier** is the longest glacier in the Karakoram range spread over a 76 km area and the second longest in the world outside of polar regions. The Siachen Glacier lies in that part of Karakoram which is referred to as the "Third Pole" of the world. The glacier is part of Ladakh, a Union Territory.

2) **Hispar Glacier** is a 49-kilometer-long glacier in the Karakoram Mountains of Gilgit–Baltistan region. It is one of four of the world's largest mountain glaciers.

51. Solution: (a)

Exp) Option a is the correct answer.

The correct arrangement of the mountain ranges from North to South is- **Karakoram (the Northernmost among the given options), followed by Ladakh, Zaskar, and Pir Panjal ranges (Southernmost among the given options).**

Option 1 - Karakoram: The Karakoram range is spread across the five countries- **Tajikistan, China, Afghanistan, Pakistan, and India.** It is surrounded by numerous mountain ranges, including the **Hindu Kush** to the west, the **Pamir** to the northwest, the **Kunlun Mountains** to the northeast, and **the Himalayas** to the southeast. The Karakoram serves as a **watershed for the basins of the Indus and Yarkand rivers.**

Option 4 - Ladakh: Ladakh range is considered as a **southeastern extension of the Karakoram range**. The range is spread across **Gilgit-Baltistan and Ladakh**. It borders the Tibet autonomous region of China. The range **runs parallel to the northeast bank of the Indus River.**

Option 2- Zaskar: Zaskar range extends across **India, and the Tibet region**. They extend in the Southeast direction **from the Karcha (Suru) River in Ladakh to the upper Karnali River (flows through Tibet, Nepal, and India).** The important passes like **Shipki La, Lipu Lekh (Lipulieke), and Mana La** lie in this range.

Option 3 - Pir Panjal: The Pir Panjal range is situated in the **Kashmir region and Himachal Pradesh**. It extends to the **upper Beas River in northwestern Himachal Pradesh state**. The major passes located in this range are **Pir Panjal pass and the Banihal pass**.

52. Solution: (a)

Exp) Option a is the correct answer.

During the **Miocene epoch** (5-24 million years ago), geologists believe a substantial river known as the **Shiwalik or Indo-Brahma** flowed along the length of the Himalayas, from Assam to Punjab, eventually emptying into the Gulf of Sind. Over time, **this river divided into three main drainage systems**: the Indus and its tributaries in the west, the Ganga and its Himalayan tributaries in the central region, and the Brahmaputra and its Himalayan tributaries in the east. **This**

division occurred due to geological shifts, such as the uplift of the Potwar Plateau (Delhi Ridge) in the western Himalayas, which acted as a water divide between the Indus and Ganga drainage systems. Therefore, the Potwar Plateau serves as a water divide between the Indus and Ganga River systems.

53. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: There is no peak with the elevation of more than 3000 meters in Western Ghats. The highest peak in Western Ghats is Anaimudi with an elevation of around 2695 meters.

Option b is incorrect: In India, cold deserts are found in Jammu and Kashmir, Ladakh, Himachal Pradesh, and Uttarakhand. The largest cold desert in India is the Ladakh desert.

Option c is incorrect: Banni Grasslands Reserve or Banni grasslands form a belt of arid grassland ecosystem on the outer southern edge of the desert of the **marshy salt flats of Rann of Kutch in Kutch District, Gujarat State, India.** They are known for rich wildlife and biodiversity.

Option d is incorrect: The **Wular lake** in Jammu and Kashmir is the result of tectonic activity. It is the **largest freshwater lake in India.** The Dal lake, Bhimtal, Nainital, Loktak and Barapani are some other important freshwater lakes. **Loktak Lake is the largest freshwater lake in Northeast India.**

54. Solution: (d)

Exp) Option d is the correct answer.

The Kumaon Himalayas are a region in the northwestern part of the Indian Himalayas, located primarily in the state of Uttarakhand.

Statement 1 is correct. The Kumaon Himalayas are located in the northwestern part of the Indian Himalayas. They are bordered by the Sutlej River in the west and the Kali River in the east. It is home to hill stations such as Nainital, Ranikhet, and Almora.

Statement 2 is correct. Nanda devi (Elevation of approximately 7817m) is the Highest plateau of this part of Himalayas. Other notable peaks in this region are - Kamet (Elevation of approximately 7756m), Trishul (Elevation of approximately 7140m), Badrinath (Elevation of approximately 7138) and Kedarnath (Elevation of approximately 6940m).

Statement 3 is correct: Lipulekh pass, the trijunction pass that connects India with China (Tibet) and Nepal, is located in this part of Himalayas. Other notable pass in this region includes- Mana Pass, Niti Pass, Lampiya Dhura pass, Tun-Jun-La pass, Shalsal pass, Balch Dhura pass etc.

55. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: The Siachen Glacier is situated in the **eastern Karakoram Range, which is a part of the greater Himalayas.** It lies near the Line of Control (LoC) between India and Pakistan, making it a strategically significant region.

Statement 2 is incorrect: While the Siachen Glacier is the **longest glacier in the Karakoram Range** (about 75 km long) and **one of the largest in the non-polar world,** it is not the longest glacier outside the polar regions. That distinction belongs to the **Fedchenko Glacier in Tajikistan,** which is about 77 km long.

Statement 3 is correct: The Nubra River **originates from the meltwater of the Siachen glacier** and flows southward into the **Nubra Valley before joining the Shyok River.**

56. Solution: (d)

Exp) Option d is the correct answer.

The Himalayas, the world's highest mountain range, are not a static feature but are actively rising due to the ongoing collision of the Indian and Eurasian tectonic plates.

Statement 1 is correct: Himalayan rivers, like the Indus, Ganges, and Brahmaputra, are young rivers. This means they have high erosive power. As the Himalayas continue to uplift, these rivers actively cut down into the rock, creating deep canyons and gorges. This ongoing downcutting is a direct result of the uplift outpacing the rate of erosion. **Thus the Himalayan rivers being in youthful stage and have rejuvenated in recent times prove that the Himalayas are still rising.**

If the upliftment stopped, the rivers would eventually widen their valleys rather than deepening them at such a rapid rate.

Statement 2 is correct: The Himalayas are a result of the **ongoing collision between the Indian and Eurasian tectonic plates.** This collision generates immense pressure, which is released in the form of earthquakes. The **frequent seismic activity is a clear indication that the tectonic forces responsible for the Himalayas' formation are still active, and the mountains are still being pushed upwards.**

Statement 3 is correct: Some of the fossil formations found in the Shiwalik hills are also available in the Tibetan plateau. It indicates that the past climate of the Tibet plateau was similar to that of the Shiwalik Hills and the elevation of the plateau was similar to Shiwalik Hills and since then it has risen to the present elevation.

Statement 4 is correct: Due to uplifting, **lakes in Tibet are desiccated** (lose water) keeping the gravel terraces at much higher levels above the present water level. This could be possible only in the event of upliftment of the region. Thus this also provides evidence that the Himalayas are rising.

57. Solution: (a)

Exp) Option a is the correct answer.

Pangong Lake, one of the most famous lakes in Leh Ladakh, derives its name from the Tibetan word, **"Pangong Tso", which means "high grassland lake".**

Statement 1 is correct: Pangong Tso is an endorheic lake (landlocked) that is partly in India's Ladakh region and partly in Tibet.

Statement 2 is incorrect: Pangong Tso(lake) is situated at a height of 14,270ft i.e 4,270m above sea level. **It is not the highest lake.** Gurudongmar lake is situated at an elevation

of around 17000 ft i.e 5183 metres above sea level. Tsho Lhamo Lake is located at a place few kilometers away from Gurudongmar Lake near Donkhyala pass at an elevation of 5,100 meter in North Sikkim.

Statement 3 is incorrect: During winter, the lake freezes completely despite being saline water.

Pangong Tso(lake) changes color appearing blue, grey-green, and red at varied points in time.

58. Solution: (a)

Exp) Option a is the correct answer.

A mountain pass is a navigable route through a mountain range or over a ridge.

Row 1 is incorrect. One of the highest motorable passes in the world, **Khardung La in Ladakh** stands at an altitude of 5,359 meters. The pass connects **Leh to Nubra Valley.**

Row 2 is correct. Rohtang Pass is a legendary mountain pass in **Himachal Pradesh, connecting Kullu valley to Lahaul and Spiti** at an altitude of 3,978 meters. The Atal Tunnel has now reduced travel time between the two locations.

Row 3 is incorrect. Sela Pass, standing at an altitude of 4,170 meters, is one of the most picturesque mountain passes in **Arunachal Pradesh,** India. It remains snow-covered for most of the year and **provides access to Tawang** through **Dirang and Guwahati.**

59. Solution: (d)

Exp) Option d is the correct answer.

On the basis of the prominent relief features, the Peninsular plateau can be divided into three broad groups:

(i) The Deccan Plateau

(ii) The Central Highlands

(iii) The Northeastern Plateau

Chotanagpur Plateau lies to the east of the Baghelkhand Plateau and **represents the north-eastern projection of the Peninsular Plateau of India and a part of Central Highlands**.

- The plateau spreads over the border areas of **Jharkhand, northern Chhattisgarh, and the western part of West Bengal.**
- The plateau witnesses a **radial drainage pattern with numerous rivers and streams flowing in different directions.**
- The prominent rivers flowing in the region are – Son, Damodar, Subarnrekha, North Koel, South Koel, and Barakar. **The rivers Damodar, Koel and Subarnarekha origin point lies in this plateau.**
- **It is also known as Ruhr of India as like the Ruhr region in Germany,** it is a major industrial hub with abundant mineral resources, particularly coal, iron ore, and other minerals, making it a crucial center for mining and manufacturing in India.

Option a is incorrect: Malwa Plateau forms a part of Central Highlands. It is composed of extensive lava flow and is covered with black soil. In the north, it is marked by Chambal ravines. **It is not considered as Ruhr of India.** It has two systems of drainage, to the Arabian Sea (Narmada, Tapi and Mahi) and the Bay of Bengal (Chambal and Betwa).

Option b is incorrect: Maharashtra plateau is part of deccan plateau and not the Central highlands..

Option c is incorrect: Marwar plateau is the plateau of eastern Rajasthan. It is not considered as the Ruhr of India.

60. Solution: (b)

Exp) Option b is the correct answer.

Block mountains are formed when large blocks of the Earth's crust are uplifted and tilted along a fault line.

Option 1 is incorrect. The Aravallis are a type of fold mountains of India. They run in the North-East to South-West direction, between Delhi and Gujarat. They represent the relict of the world's oldest mountain.

Option 2 is correct. Vindhyas are block mountains of India. It flanks the northern edge of Narmada-Son, overlooking the Narmada valley. It is composed of horizontally bedded sedimentary rocks of ancient age.

Option 3 is correct. Satpura are block mountains of India. It runs in the east-west direction, south of the Vindhyas and runs roughly parallel to Narmada and Tapi.

61. Solution: (d)

Exp) Option d is the correct answer.

There are two major island groups in India – one in the Bay of Bengal and the other in the Arabian Sea. The Bay of Bengal island groups consist of about 572 islands/islets. These are situated roughly between 6°N-14°N and 92°E -94°E. The entire group of islands is divided into two broad categories – the Andaman in the north and the Nicobar in the south.

Statement 1 is incorrect. The Ten Degree Channel separates the Andamans from the Nicobar group of islands. The Duncan Passage separates the Little Andamans from the Great Andamans.

Statement 2 is incorrect. Most of the islands are made from tertiary sandstone, limestone and shale resting on basic and ultrabasic volcanoes. The Barren and Narcondam islands are volcanic. **Some of the islands are fringed with coral reefs.**

Statement 3 is correct. Saddle Peak in the North Andamans is the highest peak of these group of islands. It lies at 738 meters. Some other peaks are: Mount Diavolo (Middle Andaman – 515 m), Mount Koyob (South Andaman – 460 m) and Mount Thuiller (Great Nicobar – 642 m).

Statement 4 is incorrect. Barren island, the only active volcano in India is also situated in the Andaman Islands. It is renowned for being South Asia's only active volcano, which last erupted in 2022.

Note: The information regarding the location of Barren Island is incorrectly stated in the NCERT. So, Kindly update your notes accordingly as the Barren Island is located in the Andaman group of Islands not in Nicobar Islands.

62. Solution: (c)

Exp) Option c is the correct answer.

The Indian Standard Meridian, which is 82°30' East Longitude, passes through five States in India. These are Uttar Pradesh, **Madhya Pradesh, Chhattisgarh,** Odisha and Andhra Pradesh.

The Tropic of Cancer (23.5 degrees N) passes through eight States in India. These are Gujarat, Rajasthan, **Madhya Pradesh, Chhattisgarh,** Jharkhand, West Bengal, Tripura, and Mizoram.

Option 1 is correct. Both the tropic of cancer as well as the Indian Standard Meridian pass through Madhya Pradesh.

Option 2 is incorrect. Only Tropic of Cancer passes through Jharkhand. Indian Standard Meridian does not pass through **Jharkhand.**

Option 3 is correct. Both the tropic of cancer as well as the Indian Standard Meridian pass through Chhattisgarh.

Option 4 is incorrect. Only Tropic of Cancer passes through West Bengal. Indian Standard Meridian does not pass through **West Bengal.**

Option 5 is incorrect. Only Indian Standard Meridian passes through Andhra Pradesh. The Tropic of Cancer does not pass through **Andhra Pradesh.**

63. Solution: (a)

Exp) Option a is the correct answer.

The tea plantation in Darjeeling was established due to a favorable agro-climatic situation and specific soil characteristics. The British established tea plantations in the Darjeeling Himalayas due to certain physical conditions of this region.

Option 1 is correct. The darjeeling himalayas **have moderate slopes.** This is advantageous for the cultivation of tea.

Option 2 is correct. The darjeeling himalayas have **thick soil cover with high organic content.** This is very suitable for tea cultivation and thus the British introduced tea plantations in this region.

Option 3 is incorrect. As compared to the other sections of the Himalayas, Darjeeling Himalayas and Arunachal Himalayas are conspicuous **by the absence of the Shiwalik formations.** In place of the Shiwaliks here, **the 'duar formations' are important**. These duar formations have been used for the development of tea gardens.

Important Tips

Also in the darjeeling himalayas, the rainfall is well distributed throughout the year. This favoured the introduction of tea plantations in this region. Also, this region has mild winters, which favoured the introduction of tea plantations in this region.

64. Solution: (c)

Exp) Option c is the correct answer.

India experiences a diverse pattern of rainfall due to its varied topography and climatic influences. The distribution of rainfall is influenced by factors such as the monsoon winds, orographic barriers, and regional geographical features.

The correct descending order of average annual rainfall for the given regions is as follows:

1. **Jaintia Hills (Meghalaya) – High Rainfall:**
   a) The hills of Meghalaya, including the Jaintia Hills, receive extremely high rainfall, often exceeding 1,000 cm in certain areas like Cherrapunji and Mawsynram.
   b) These regions fall under Areas of **High Rainfall (above 200 cm).**
2. **Cachar Valley (Assam) – Medium Rainfall:**
   a) Located in Assam, Cachar Valley receives rainfall in the range of **100-200 cm.**
   b) It is classified under Areas of Medium Rainfall, and it gets less rainfall than Jaintia Hills.
3. **Deccan Plateau – Low Rainfall:**
   a) The Deccan Plateau receives rainfall between **50-100 cm**, making it part of the Areas of Low Rainfall.
   b) Some areas may receive slightly higher rainfall, but overall, it remains significantly lower than Jaintia Hills and Cachar Valley.
4. **Ladakh – Inadequate Rainfall:**
   a) Ladakh falls in the Areas of Inadequate Rainfall, receiving **less than 50 cm** of annual rainfall due to its location in the rain shadow of the Himalayas.
   b) It is one of the driest regions in India.

Thus, the **correct order from highest to lowest rainfall is Jaintia Hills > Cachar Valley > Deccan Plateau > Ladakh.**

65. Solution: (a)

Exp) Option a is the correct answer.

The Andaman and Nicobar Islands, located in the southeastern part of the Indian Ocean, are a unique group of islands with strategic importance and diverse geographical features.

Statement 1 is correct: The Andaman & Nicobar Islands are separated by a water body which is called the Ten Degree Channel, which distinguishes the two island groups. The Andaman group lies to the north of the channel, while the Nicobar group lies to the south.

Statement 2 is incorrect: Barren Island is located in the Andaman Sea, about 138 kilometers northeast of Sri Vijaya Puram (Earlier Port Blair), the capital of the Andaman and Nicobar Islands.

Statement 3 is incorrect: It is believed that these islands are an elevated portion of submarine mountains. Some parts of the Andaman & Nicobar Islands have coral deposits, the islands are primarily of volcanic origin and not entirely built of coral deposits.

66. Solution: (d)

Exp) Option d is the correct answer.

Western Ghats are locally known by different names such as Sahyadri in Maharashtra, Nilgiri hills in Karnataka and

Tamil Nadu and Annamalai hills and Cardamom hills in Kerala. Western Ghats are comparatively higher in elevation and more continuous than Eastern Ghats. Their average elevation is about 1,500 m with the height increasing from north to south.

Statement 1 is incorrect: 'Anaimudi' (2,695 m), the highest peak of the Peninsular plateau is **located on the Annamalai hills of the Western Ghats** followed by Dodabetta (2,637 m) on the Nilgiri hills.

Statement 2 is correct: The **Eastern and the Western Ghats meet each other at the Nilgiri hills in Tamil Nadu.**

- Nilgiris is located at the tri-junction of the Indian States – Karnataka, Kerala and Tamil Nadu.

Statement 3 is incorrect: The **Nagavali and Vamsadhara rivers originate in the Eastern Ghats.**

Major rivers that originate in the Western Ghats and flow toward east are Godavari, Krishna and Kaveri. Other rivers that originate in Western Ghats include Bhima, Malaprabha, Hemavathi etc.

67. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: The **Meghalayan Plateau is an extension of the main Peninsular plateau.** It is believed that due to the force exerted by the northeastward movement of the Indian plate at the time of the Himalayan origin, a huge **fault was created between the Rajmahal hills and the Meghalaya plateau.** Later, this depression got filled up by the deposition activity of the numerous rivers. At present, the **Meghalaya and Karbi Anglong plateau stand detached from the main Peninsular Block.**

Statement 2 is correct: Similar to the Chotanagpur plateau, the Meghalaya plateau is also **rich in mineral resources like coal, iron ore, sillimanite, limestone and uranium.**

Statement 3 is incorrect: The Mishmi Hills are not part of the Meghalayan Plateau. They are located in the northeastern part of India in Arunachal Pradesh and occur at the junction of Northeastern Himalaya and Indo-Burma ranges.

The Meghalaya plateau is sub-divided into Garo Hills, Khasi Hills and the Jaintia Hills. These hills are named after the tribal groups inhabiting this region. An extension of this is also seen in the Karbi Anglong hills of Assam.

Statement 4 is correct: The **Kopili originates in the Meghalaya plateau** and flows through Central Assam and the hill districts of Assam before its confluence with the Brahmaputra.

68. Solution: (d)

Exp) Option d is the correct answer.

In the Himalayan Mountains, the decrease in temperature with increasing altitude leads to a corresponding change in natural vegetation. The Himalayan ranges thus show a succession of vegetation from the tropical to the tundra, which change with the altitude.

Option 3: Deciduous forests are found in the foothills of the Himalayas.

They are found where annual rainfall is 100 to 200 cm and mean annual temperature is about 27°C. The trees drop their leaves when sufficient moisture is not available during

the spring and early summer.

Option 1: Deciduous forests are **succeeded by the wet temperate type of forests** between an **altitude of 1,000-2,000 m.**

These forests mostly occur where annual rainfall is between 150 cm to 250 cm. They cover the entire mountain range in Kashmir, Himachal Pradesh, Uttarakhand, Darjeeling and Sikkim.

Option 2: Pine forests are well-developed between **1,500-1,750 m.** They are found in the higher hill ranges of northeastern India, hilly areas of West Bengal and Uttaranchal. Chir Pine is a very useful commercial tree here. The trees here provides valuable timber for boxes, furniture and buildings.

Option 4: Temperate grasslands are found at altitudes of 2,225-3,048 m. They are found in cold arid areas of Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, West Bengal and the northeastern states.

69. Solution: (c)

Exp) Option c is the correct answer.

Option c is correct: The correct chronological order of the above-mentioned peaks in the east to the west order is: **Annapurna – Dhaulagiri – Nanda Devi – Kamet.**

1. **Annapurna** stands at 26,545 feet (8,091 meters), ranking tenth highest globally. It is located in the Gandaki province of **north-central Nepal.** It is part of the Himalayas in Nepal.
2. **Dhaulagiri** stands as the world's seventh-highest mountain, reaching 26,795 feet (8,167 meters) above sea level. It is **located in west-central Nepal.** It is situated on the **western side of the deep Kali (Kali Gandaki)** River gorge.
3. **Nanda Devi** is the **second-highest mountain in India.** It is **part of the Kumaon Himalayas** and is located in the state of **Uttarakhand,** between the Rishiganga valley on the west and the Goriganga valley on the east.
4. **Kamet** is the **second-highest mountain** in the Garhwal region of Uttarakhand, after Nanda Devi. It is located in the Chamoli District of **Uttarakhand, close to the border with Tibet.**

70. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Kangra valley in Himachal Pradesh is an example of Strike valley. The Kangra valley extends from the foothills of Dhauladhar ranges to the south of Beas river. **A strike valley forms parallel to the layers of rock underneath** it. It is usually a long, narrow valley that runs in the same direction as the rock layers.

Statement 2 is correct: Kulu valley is situated in the state of Himachal Pradesh. The **Kullu valley is a transverse valley** situated between the mountain ranges of Pir Panjal and Dhauladhar range. **Transverse valley forms at right angles to the direction of the rock layers.** These valleys are often shaped by erosion, like rivers cutting across the rock layers.

Statement 3 is correct: The river Narmada and Tapi flow **through the rift valley, caused due to upheaval of the Himalayas, between the Satpura in the south and the Vindhyan range in the north.**

71. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is incorrect. Zoji La is a high mountain pass in the Great Himalayas. It is located in Kargil district of Ladakh. The mountain pass links Leh and Srinagar and provides an important link between Union Territories of Ladakh and Kashmir. Zoji La is located at an altitude of 11,650 ft. Zoji la is known as the "Mountain Pass of Blizzards".

Pair 2 is incorrect. Banihal pass lies in the Pir Panjal range. Banihal Pass is a high mountain pass located in the Pir Panjal range in the Jammu and Kashmir region. Banihal has always been known as the gateway connecting Jammu and Srinagar which was made famous by the 2.5km long Jawahar tunnel and now the Banihal-Qazigund rail tunnel.

Pair 3 is correct. Fotu La is a high mountain pass in the Zanskar range. It is a mountain pass on the Srinagar-Leh highway.

Pair 4 is incorrect. Khardung La pass lies in the Ladakh Range. It is located in the Leh district of Ladakh.It is the second highest motorable pass in the world after Umling la pass. Khardung la is the gateway to Shyok and Nubra valleys. It is located at an altitude of 18,379ft (5602m).

72. Solution: (b)

Exp) Option b is the correct answer.

The Thar Desert, also known as the Great Indian Desert, is a large, arid region in the northwest corner of the Indian subcontinent.

Statement I is correct: The Thar Desert, also known as the Great Indian Desert, **receives minimal rainfall about 4 inches (100 mm) or less in the west to about 20 inches (500 mm) in the east due to its arid climate and specific geographical factors**. Thar Desert, also known as the Great Indian Desert, is located in the rain shadow region of the Aravalli Range. The Aravalli Range is a mountain range in the northwest of India that runs parallel to the Thar Desert.

Statement II is correct: The Thar Desert has **no large perennial rivers flowing through it**. The desert primarily relies on underground water reserves and the limited monsoon rains. The Luni River is the only river in the Thar Desert. It is a non-perennial river that only flows during the monsoon season and dries up during extended dry periods.

Statement II does not explain statement I: While the lack of perennial rivers can worsen the water scarcity situation in the desert, it's not the cause of low rainfall creating desert like conditions. The low rainfall is primarily due to the geographical factors like the rain shadow region of the Aravalli Range.

73. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: Uttar Pradesh shares borders with the maximum number of other Indian states. Uttar Pradesh shares border with 8 states and 1 union territory- Delhi, Haryana, Himachal Pradesh, and Uttarakhand in North, Bihar and Jharkhand in the east, Rajasthan in West and Madhya Pradesh and Chhattisgarh in the south.

Statement 2 is correct: Bangladesh is the neighboring country with which India shares the longest border (among India's other neighboring countries). Indo-Bangladesh border is of 4096.7 km in length. India shares borders with other countries- China (3488 kms), Pakistan (3323 kms), Nepal (1751 kms), Myanmar (1643 kms), Bhutan (699 kms), and Afghanistan (106 kms).

Statement 3 is incorrect: India has a land frontier of 15,200 km, sharing land borders with seven countries (Afghanistan, Pakistan, China, Bhutan, Nepal, Myanmar, and Bangladesh). **Bangladesh, China, and Nepal share borders with the five Indian States, whereas Myanmar shares borders with the four Indian States.** Hence, the statement given is incorrect.

Details of Indian States sharing borders with the neighboring countries are:

Neighboring Country	Bordering States	Number of States and UTs
1. Bangladesh	West Bengal, Assam, Meghalaya, Tripura and Mizoram.	5
2. Pakistan	Gujarat, Rajasthan, Punjab, Union Territory of Jammu & Kashmir and Union Territory of Ladakh.	4
3. China	Arunachal Pradesh, Sikkim, Uttarakhand, Himachal Pradesh and Union Territory of Ladakh.	5
4. Nepal	Uttarakhand, Uttar Pradesh, Bihar, West Bengal and Sikkim.	5
5. Bhutan	Sikkim, West Bengal, Assam and Arunachal Pradesh.	4
6. Myanmar	Arunachal Pradesh, Nagaland, Manipur and Mizoram.	4
7. Afghanistan	Union Territory of Ladakh	1

Statement 4 is incorrect: India has a coastline of approximately 7516 km in length. Among the Indian States,

Gujarat has the longest coastline of 1214.7 km. On the other hand, the coastline of Maharashtra is 652.6 km. Hence, the given statement is incorrect.

Andaman and Nicobar Islands have the overall longest coastline of 1962 km.

74. Solution: (b)

Exp) Option b is the correct answer.

Lakes are amongst the most varied features of the earth's surface. They occupy the hollows of the land surface in which water accumulates. They vary tremendously in size, shape, depth and mode of formation.

Pair 1 is correct: Vembanad, one of the Ramsar site, is a coastal lagoon. It has a single, relatively narrow opening to the sea and must have been formed by the detritus dumped by six perennial rivers forming a narrow sand bar in the sea further west of the seashore.

Pair 2 is correct: Tectonic lakes are lakes formed as a result of the deformation of the Earth's crust and the resulting lateral and vertical motions. These motions include faulting, tilting, folding, and warping. **Wular Lake is one of Asia's largest freshwater lakes, having been produced by geological action. Hence, it is type of tectonic lake.**

Pair 3 is incorrect: Vynthala Lake is a natural oxbow lake found in Vynthala, near Mala, Thrissur District of Kerala. It was formed from a "cut-off" of the Chalakudy River which flows near to it. The lake is considered to be the only naturally formed Oxbow Lake in whole of South India.

75. Solution: (c)

Exp) Option c is the correct answer.

Island is any area of land smaller than a continent and entirely surrounded by water.

Pair 1 is correctly matched: Kiltan Island is a coral island belonging to the Amindivi Subgroup of islands of Lakshadweep.

Pair 2 is incorrectly matched: Ghoramara Island is in the Sundarban Delta of the Bay of Bengal. The island is small, roughly five square kilometers in area, and is quickly disappearing due to erosion and sea level rise.

Pair 3 is correctly matched: Pirotan Island is located in the Gulf of Kutch in Jamnagar District of Gujarat. Marine National Park and Sanctuary Pirotan is located in the inter-tidal zone along the coastal area of Jamnagar.

Pair 4 is incorrectly matched: Baratang Island is a part of the Andaman and Nicobar Island off the coast. It is located between South and Middle Andaman.

76. Solution: (c)

Exp) Option c is the correct answer.

Hills	Region
1. Cardamom Hills	Western Ghats
2. Kaimur Hills	Vindhya Range
3. Mahadeo Hills	Central India
4. Mikir Hills	North-East India

- Cardamom Hills is in southeastern Kerala, forming part of the Western Ghats range.
- Kaimur Range is the eastern portion of the Vindhya Range, starting near Katangi in the Jabalpur district of Madhya Pradesh and running generally east for a distance to Sasaram in Bihar.
- Mahadeo Hills is located in the northern part of the Satpura Range, in southern Madhya Pradesh, central India.
- Mikir Hills are a group of hills located to the south of the Kaziranga National Park, Assam. The easternmost Meghalaya comprising the detached Mikir Hills is partly isolated being surrounded by three sides. It is part of the Karbi-Plateau.

77. Solution: (d)

Exp) Option d is the correct answer.

The Shola forests of Western Ghats are found in the upper reaches of the Nilgiris, Anamalais, Palni hills, Kalakadu, Mundanthurai and Kanyakumari in the states of Tamil Nadu and Kerala. These forests are found sheltered in valleys with sufficient moisture and proper drainage, at an altitude of more than 1,500 metres. The upper reaches are covered with grasslands, known as Shola grasslands.

Option d is correct.

Features of Shola forests:

- The vegetation that grows in Shola forests is evergreen. The trees are stunted and have many branches. **Generally, the leaves are small in size and leathery. Red-coloured young leaves turning into different colours on maturity is a prominent characteristic of the Shola forests. Epiphytes like lichens, ferns and bryophytes usually grow on the trees.**
- **The rolling grasslands are found on top of the Western Ghats.** Shola forests and grasslands are found in a ratio of 1:5.

78. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. The Indian Himalayan Region is spread across 13 Indian States/Union Territories. In India, the Himalayas are spread over Jammu and Kashmir, Ladakh, Uttarakhand, Himachal Pradesh, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, Tripura, Assam and West Bengal), stretching across 2500 km.

Statement 2 is incorrect. The Western Ghats is one of the eight hotspots of biological diversity in the world and is spread across six states—Gujarat, Maharashtra, Goa, Karnataka, Tamil Nadu and Kerala.

Statement 3 is correct. Pulicat Lake is located at border of Andhra Pradesh and Tamil Nadu. It is spread across two states only.

79. Solution: (c)

Exp) Option c is the correct answer.

Sundarbans is a mangrove area in the delta formed by the confluence of the Ganges, Brahmaputra and Meghna Rivers in the Bay of Bengal. It spans the area in West Bengal and Bangladesh.

Statement 1 is correct: The **Ganges Brahmaputra Delta,** also named **Ganges Delta, Sunderban Delta** or Bengal Delta is located in Asia which is the floodplain of three great rivers: **the Ganges, the Brahmaputra and the Megna.** Together, these three rivers drain a catchment of about 1.72 million km2, at the southern side of the Himalaya.

Statement 2 is correct: The distance from the confluence of the Brahmaputra and the Ganges to the coast is around 250 km. Along the coast, the width of the delta is measured to be approximately 350km. It is considered to be the world's largest Delta, having a surface area of around 100.000 km2. **Approximately two-thirds of the delta is in Bangladesh, the rest constitutes the state of West Bengal, India.**

80. Solution: (b)

Exp) Option b is the correct answer.

The Himalayas is the highest mountain system of the world. It extends in arc shape for a distance of about 2500 km from west to east along the northern boundary of India. The breadth of the Himalayas ranges between 400 km in the west to 150 km in the east.

Statement 1 is incorrect: the Eastern Himalayas rise nearly abruptly from the plains of West Bengal and Assam. This is the reason why we find highest peaks of Himalayas in the east. For example, two of the highest peaks of Himalayas, i.e. Mt. Everest (in Nepal) and Kanchenjunga are in the east and they are not very far from the plains. On the other hand, the **western part of Himalayas rises rather gradually from the plains.**

Statement 2 is correct: As Western Himalayas rises gradually from the plains, therefore, **the higher peaks in this part are farther from the plains** and a number of ranges lie between the plains and high peak, for example, Shivaliks, Lesser Himalayan Ranges, etc. Therefore, the high peaks of this part such as Nanga Parbat, Nanda Devi and Badrinath are very far from the plains.

81. Solution: (c)

Exp) Option c is the correct answer.

The Himalayas is the highest mountain system of the world. It extends in arc shape for a distance of about 2500 km from west to east along the northern boundary of India.

Statement 1 is correct: The **river Indus flows towards northwest between Zaskar range and Ladakh range.** A Himalaya range which is located to the north and runs almost parallel of the Himadri/Great Himalayas is Zaskar range. Further, to the north of Zaskar range is the Ladakh range. Further, North of the Ladakh range lie the Karakoram. Many scholars treat Zaskar and Ladakh ranges as parts of the Great Himalayas and include them in Kashmir Himalayas.

Statement 2 is incorrect. K2 (8611m) is the second highest peak of the world, next only to Mt. Everest. **It is also the highest peak of the Karakoram Mountains.**

Statement 3 is correct. The three major ranges of the Himalayas are the Great Himalayan Ranges/Himadri, Lesser Himalayan Ranges/the Himachal and the Siwalik ranges. Further, to the north of Great Himalayas, The Zaskar, the Ladakh and the Karakoram ranges along with their eastern extension, **Kailash in Tibet** are considered as the **trans Himalayan ranges.**

82. Solution: (b)

Exp) Option b is the correct answer.

The climate of India is described as the 'monsoon' type. Despite an overall unity in the general pattern, there are perceptible regional variations in climatic conditions within the country. These variations have given rise to variety in lives of people – in terms of the food they eat, the clothes they wear and also the kind of houses they live in.

Statement 1 is correct: The temperature in Rajasthan can be extremely high during summers. Also, during winters, it gets very cold there. **The thick walls prevent the heat and cold from affecting the people in the houses.** Flat roofs are made as rainfall is scanty there. It helps in the collection of rainwater on the roof.

Statement 2 is correct: The houses in the Tarai region, Goa and Mangalore are constructed with sloping roofs as these places are heavy rainfall areas. The monsoons shed a vast amount of moisture here. **So, the shape of the roof enables the extra water to move down to the ground.**

Statement 3 is incorrect: Assam lies in the high monsoon rainfall region of India. Being in the northeast and affected by southwest monsoons, it can be prone to floods due to heavy rainfall. So, houses are built on stilts, **to prevent water from entering homes and damaging the property.**

5.2. Drainage System

83. Solution: (d)

Exp) Option d is the correct answer

Pair 1 is incorrect: The **Thamiraparani river is the only perennial (continuous flow of water) river in Tamil Nadu.** This is the **shortest river in the state, the Thamirabarani starts in Pothigai hills of the Western Ghats in the Ambasamudram taluk, flows through Tirunelveli and Thoothukudi districts and empties at Korkai into the Gulf of Mannar** (Bay of Bengal). It thus originates and ends in the same state.

Pair 2 is incorrect: Sukapaika is one of the several distributaries of the mighty Mahanadi river in Odisha. It **branches away from the Mahanadi at Ayatpur village in Cuttack district and flows for about 40 kilometres (km) before rejoining its parent river at Tarapur** in the same district. Sukapaika river is an important system of the Mahanadi to control floodwater and maintain the flow in the river as well as the Bay of Bengal.

Pair 3 is correct: Bhogdoi river originates from Mokokchung

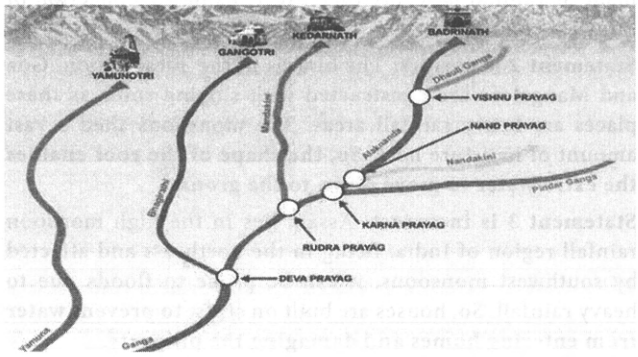
in Nagaland where it is also known as Tsujenyong nullah and is the south bank tributary of the River Brahmaputra. **It is an inter-state river (flowing between Assam and Nagaland) and joins Dhansiri river** near its confluence with Brahmaputra.

Pair 4 is correct: The **Lukha river is located in the southern part of east Jaintia Hills of Meghalaya where most of Meghalaya's rat-hole coal mines are located. It** has become a victim of the unsustainable large-scale mining of coal and limestone, allegedly responsible for the pollution that turns the river its surreal winter hue. It **receives water from the Lunar river (Wah Lunar) and small streams draining from the Narpuh Reserve Forest** and the undulating hills of the area while flowing down.

84. Solution: (a)

Exp) Option a is the correct answer.

The Ganga is the most important river of India both from the point of view of its basin and cultural significance. It rises in the Gangotri glacier near Gaumukh (3,900 m) in the Uttarkashi district of Uttarakhand. Here, it is known as the Bhagirathi. It cuts through the Central and the Lesser Himalayas in narrow gorges.



Pair 1 is incorrect: At Devprayag, the Bhagirathi meets the Alaknanda. It is the last Prayag of the Alaknanda river, from here the confluence of Bhagirathi and Alaknanda is known as Ganga.

Pair 2 is correct: At Vishnu Prayag (also known as Joshimath), Dhauli Ganga and Vishnu Ganga meet. From here the confluence of these two rivers is known as Alaknanda.

Pair 3 is incorrect: At Karna Prayag, Alaknanda meets Pindar river that originates from the Pindar glacier, below the Nanda devi mountain range.

Pair 4 is incorrect: Mandakini meets Alaknanda at Rudra Prayag. The confluence is named after god Shiva, who is also known as Rudra.

85. Solution: (b)

Exp) Option b is the correct answer.

The Godavari River has one of the largest basin areas of 3,12.812 sq km (9.5% of India) which is larger than even that of the Brahmaputra in Indian territory. The source of this river is in the **Trimbak Plateau of North Sahyadri near Nashik in Maharashtra** which is only 80 km from the shore of the Arabian Sea. 48.6 percent of its basin area lies in **Maharashtra**, 23.8 per cent in **Andhra Pradesh and Telangana**, 20.7 percent in **Madhya Pradesh and Chhattisgarh**, 5.5 per cent in **Odisha** and only 1.4 percent in **Karnataka**. The Godavari is the **largest river system of the Peninsular India** and is next only to the Ganga and the Indus Systems regarding sanctity, utility and is held in **reverence as Vridha Ganga or Dakshin Ganga.** Its total **length is 1,465 kilometres.** From its source it flows eastwards in a narrow rocky bed unto Nashik, but the river valley opens out below this point. It has both left and right bank tributaries, but the **left bank tributaries are more in number and larger in size** than the right bank tributaries. The Manjra is the only important right bank tributary. **The Penganga, the Wardha, the Wainganga, the Indravati and the Sabari are important left bank tributaries.** Below Rajahmundry, the river divides itself into two main streams, the **Gautami Godavari on the east and the Vashishta Godavari** on the west and forms a **large delta before it pours into the Bay of Bengal.**

86. Solution: (a)

Exp) Option a is the correct answer.

The Himalayan drainage system has evolved through a long geological history. It mainly includes the Ganga, the Indus and the Brahmaputra river basins which drains into Bay of Bengal. The reason for the same is as follows:

Option a is correct – It is opined that in due course of time Indo– Brahma river was dismembered into three main drainage systems **The dismemberment was probably due to the Pleistocene upheaval in the western Himalayas, including the uplift of the Potwar Plateau (Delhi Ridge), which acted as the water divide between the Indus and Ganga drainage systems.** Likewise, the downthrusting of the Malda gap area between the Rajmahal hills and the Meghalaya plateau during the mid-pleistocene period, diverted the Ganga and the Brahmaputra systems to flow towards the Bay of Bengal

Option b is incorrect – Although being Perennial is one of the condition but not necessary condition. The Peninsular rivers like Godavari and Krishna are non-perennial but still drains in Bay of Bengal.

Option c is incorrect – Both the east and west flowing rivers have tributaries. For example River Narmada has several tributaries like Tawa, Heran, Banjar, Beda etc. Even Tapi river has tributaries like Purna, Girna etc. Similarly, east flowing rivers also has several tributaries. It is also not the reason for rivers to flow eastward.

Option d is incorrect – It is not related to the drainage pattern of rivers. Drainage pattern evolves over ages and not due to mere deflection. Coriolis force is least at equator and increases towards poles. It creates deflection to the right of moving object in Northern Hemisphere whereas the rivers have taken a left course. The option was meant to confuse the aspirant.

87. Solution: (d)

Exp) Option d is the correct answer.

The southern slopes of Shiwalik range in Punjab and Himachal Pradesh are almost devoid of forest cover. The **northern part of Punjab-Haryana plain adjoining Shiwalik hills has been intensively eroded by numerous seasonal streams called chos.** The soil erosion by these streams has led to enormous gullying in the punjab plains.

Option a is incorrect Bugyals are alpine pasture lands, or meadows, in higher elevation range between 3,300 metres (10,800 ft) and 4,000 metres (13,000 ft) of the Himalayas in the Indian state of Uttarakhand, where they are called "nature's own gardens".

Option b is incorrect: Duns – the duns or duars are the valleys found in the Shiwalik range, these are open valleys between the Shivalik and the higher Himalayan foothills. These duns are longitudinal valleys which are formed due to folding which occurs when the Eurasian and the Indian plate collide with each other

Option c is incorrect: In the Thar Desert, the shifting sand dunes are locally known as Dhrian

88. Solution: (b)

Exp) Option b is the correct answer.

The flow of water through well-defined channels is known as 'drainage' and the network of such channels is called a 'drainage system'. The Drainage pattern refers to the system of flow of surface water mainly through the forms of rivers and basins. It depends upon factors such as slope of land, geological structure, amount of volume of water and velocity of water.

In Centripetal Drainage Pattern, the streams converge from all sides in the low-lying basins, wherein, stream flows towards a central depression. It is similar to the radial drainage system, with the only exception that radial drainage flows out whereas the centripetal drainage flows in. **The Loktak lake in Manipur is a classic example of this type of drainage pattern.**

The streams of Ladakh, Tibet, and the Baghmati and its tributaries in Nepal also follow this pattern of drainage

Option a is incorrect: Streams from Vindhyan range follow a rectangular drainage pattern which is prevalent in the faulted area. It grows in a tightly packed rocky ground. The streams choose the path of least resistance and hence congregate in areas with the weakest exposed rock.

Option c is incorrect: Streams originating from the Amarkantak hills such as Narmada, Son and Mahanadi follow Radial drainage pattern. In this, the tributaries from a summit follow the slope downwards and drain down in all directions.

Option d is incorrect: Rivers of Indo-Gangetic plains follow Dendritic drainage pattern. It forms a branching structure similar to tree roots.

89. Solution: (d)

Exp) Option d is the correct answer.

The Rivers of India carry huge volumes of water per year, but it is unevenly distributed both in time and space. During the rainy season, much of the water is wasted in floods and flows down to the sea. We use river waters for a variety of purposes such as **irrigation, hydro-electric production, navigation** etc. **Large quantity of water is supplied to cities and villages for domestic consumption.** A large number of **industries also depend** upon water.

Option1 is correct: Rivers and streams **transport water and sediment** downslope to lakes and oceans. This **natural processing, which sorts sediments and minerals** according to their physical properties, serves as a mechanism by which **potentially valuable earth deposits are concentrated to a point** where it is **economically feasible to extract them for human use.** These resources may be **metallic as in tin, gold and platinum placer deposits** or nonmetallic such as **deposits of sand and gravel.**

Option 2 is correct: Usability of Rivers Rivers are of great use for us because they comprise a great **source of freshwater for drinking purposes.** In fact, most of our requirements of freshwater are met by rivers. **The largest amount of river water is used for irrigation.** Almost **30 percent of the annual flow** of the Indian rivers is used for irrigation through **canals.**

Option 3 is correct: Large rivers have gem **waterpower potential.** The large rivers of **Himalayas Vindhyas, the Satpura, hills in the northeast, and Western and the Eastern Ghats** offer possibilities of large-scale waterpower development. The Himalayan rivers are mostly **perennial.** They however have issues of area for storage on account of **narrow valleys, high seismicity** of the region and vast alluvial plain with no variation of relief.

Option 4 is correct: The **Gangs and the Brahmaputra** in the north and north-eastern part of the country, the **Mahanadi,** the **Godavari** and the **Krishna** and the **lakes and tidal creeks** in coastal states possess some of the important and **useful waterways of the country.** In the past they were of great importance, which suffered a great deal with the advent of rail end roads.

Option 5 is correct: River ecosystems have **tremendous potential to store CO2,** however, with **changing climatic and anthropogenic activities,** these habitats are under threat, and river ecosystems are losing the very vital service of **storing carbon.** Unlike well documented terrestrial biodiversity, the **biodiversity in aquatic ecosystems** is still unrecognized to some extent. They are also important as they provide **swimming, recreational facilities** to the visitors.

90. Solution: (d)

Exp) Option d is the correct answer.

The Narmada is the largest of all the west-flowing flowing rivers of the Peninsular India. It **rises from the western flanks of the Amarkantak plateau in Shahdol district of Madhya Pradesh** and flows westwards through a **rift valley between the Vindhya Range on the north and the Satpura Range** on the south. Its total length from its source in Amarkantak **to its estuary in the Gulf of Khambhat is 1,310 km.** It flows through **Madhya Pradesh, Maharashtra**

and Gujarat. Tributaries and the main stem river drain the surrounding drainage basin of its surface water and groundwater, leading the water out into an ocean. **Burhner, Banjar, Sher, Shakkar, Dudhi, Ganjaland and Tawa are the left bank and the Tendon, the Barn, the Kolar are right bank tributaries of the Narmada River. Sardar Sarovar Dam**, Maheshwar Dam, Maan Dam, Indira Sagar Dam, Bargi Dam are important reservoirs on the river. **It is also known as the Lifeline of Gujarat and Madhya Pradesh** for its huge contribution to the states.

91. Solution: (a)

Exp) Option a is the correct answer.

The important eastward flowing rivers of India from North to South are as follows:

Option 2: The Subarnarekha originates from the **Ranchi Plateau in Jharkhand** forming the boundary between West Bengal and Odisha in its lower course. It joins the Bay of Bengal forming an estuary between the Ganga and Mahanadi deltas. Its total length is 395 km.

Option 4: The Baitarani is one of six major rivers of Odisha. **Venerated in popular epics and legends, the** Baitarani River is a **source of water for agricultural irrigation.** A major portion of the river basin lies within the state of Odisha, while a small patch of the upper reach lies in **Jharkhand state**. Due to **drainage into the Bay of Bengal**, its water becomes salty as it heads towards the end of the river.

Option 1: The Brahmani is a major seasonal river in the Odisha state of eastern India. The Brahmani is formed by the confluence of the Sankh and South Koel rivers **in southern Bihar state**, the Brahmani flows for 480 km. It winds generally south-southeast and then turns east to **join northern branches of the Mahanadi River,** which then empties into the Bay of Bengal.

Option 3: The Pennar (also known as Penna, Pinakini, Pennar, Penner, Penneru, Pennai) is one of the major rivers of the peninsula. The Pennar rises in the **Chennakesava hill of the Nandidurga range, in Chikkaballapura district of Karnataka** and flows towards the east eventually draining into the Bay of Bengal. The river's total length is 597 km.

Option 5: The **Vaigai** originates in **Varusanadu Hills of western Tamil Nadu.** It initially flows northeast through the Kambam and Varushanad valleys. In its central reaches the Vaigai flows eastward into the **Vaigai reservoir at Narasingapuram**. Later it bends to the southeast, passing Madurai on its **course to its mouth on Palk Strait**, which separates the south-eastern coast of India from Sri Lanka.

92. Solution: (c)

Exp) Option c is the correct answer.

Recently, a suspension bridge collapsed over the river Machchu, in Gujarat's Morbi district, which killed almost 135 people.

Statement 1 is correct: The Machchhu river originates from Madla hills in the Surendranagar district of Gujarat. The suspension bridge, or Jhulta Pul, was built by the ruler of the princely state of Morbi, Sir Waghji Thakor, in 1877 on this river.

Statement 2 is incorrect: The river flows downstream and ends into the Great Rann of Kachchh and not into the Gulf of Khambat.

Statement 3 is correct: The river originates in the Surendranagar district and then flows through the district of Morbi. The Morbi district is famous for its ceramic industry. Around 70% of India's ceramics are produced in Morbi, and ceramic tiles manufactured here are exported to countries in the Middle East, East Asia, and Africa.

93. Solution: (c)

Exp) Option c is the correct answer.

The Brahmaputra, one of the largest rivers of the world, has its origin in the Chemayungdung glacier of the Kailash range near the Manasarovar Lake. From here, it traverses eastward longitudinally in a dry and flat region of southern Tibet, where it is known as the Tsangpo, which means the purifier. The Rango Tsangpo is the major right-bank tributary of this river in Tibet. It emerges as a turbulent and dynamic river after carving out a deep gorge near Namcha Barwa under the name of Siang or Dihang. It enters India west of Sadiya town in Arunachal Pradesh. With a total length of 2,900 km the Brahmaputra is one of the longest rivers of the world and passes through Tibet, India and Bangladesh.

Option 1, 2, 4 and 5 are correct: Streams merging with the Brahmaputra from the right are **Subansiri, Kameng, Belsiri, Dhansiri, Nyera Ama, Manas, Sankosh, Champaman, Gangadhar, Raidah, Dharla and Tista**. Those pouring in the main river from the **left are the Dibm, Burhi Dihing, Noa Dihing, Dikhu, Dhansiri and Kalang**. After receiving its **main left bank tributaries Dibang or Sikang and Lohit it is known as the Brahmaputra.**

Option 3 is incorrect: The Barak River rises from the Manipur hills, south of Mao in Senapati district of Manipur at an elevation of 2,331 m. It flows 900 kilometres through the **states of Manipur, Nagaland, Mizoram and Assam** in India. Further it enters Bangladesh and bifurcates into Surma river and Kushiyara river which converges again to become Meghna River.

94. Solution: (c)

Exp) Option c is the correct answer.

The Himalayas are drained by many rivers. These rivers originate from the **snowy mountains of Himalayas** and flows. Due to **high atmospheric pressure** at Himalayas Mountain **water vapours freeze as ice and in the summer due to heat ice begin melting** as water and it flows from Himalayas to the downwards plain areas as rivers.

Option1 is correct: River Sutlej originates outside India, near Rakastal at Mount Kailash, Tibet plateau. It enters India through Shipki la Pass. The river Sutlej is known as **Langqen Zagbo inside Tibet/China**. The river is the **easternmost tributary of the Indus River**. The Sutlej River usually runs according to a **west to southwest** itinerary

moving into India via the **Shipki La Pass** located in Himachal Pradesh.

Option 2 is correct: The Brahmaputra is a trans-boundary river which **originates from the Kailash ranges of Himalayas**. After flowing through Tibet, it **enters India through Arunachal Pradesh and flows through Assam and Bangladesh before it joins the Bay of Bengal.** It is also known as the **Yarlung Tsangpo** in Tibet, the **Siang/Dihang River** in Arunachal Pradesh, **Lohit and Brahmaputra** in Assam, and **Jamuna** River in Bangladesh.

Option 3 is correct: The Indus is a transboundary river of Asia and a **trans-Himalayan River of South and Central Asia.** The **Kailash range glaciers at Manasarovar Lake** are the source of the Indus River. The Indus River has a length of around 2880 km, of which only 710 km are in the Indian state of Jammu & Kashmir. The Indus River known as **Singhi Khamban or Lion's Mouth** near its origin.

Option 4 is incorrect: The source of Yamuna lies in the Yamunotri Glacier on the southwestern slopes of **Banderpooch peaks**, which lie in the Mussoorie range of the Lower Himalayas, north of Haridwar in **Uttarakhand**. So, option 4 is incorrect.

Statement 5 is correct: Gandak River rises in the glacial of southern Tibet at altitude of 7,620 mt near Tibet Nepal border. Gandak River, also called **Narayani River**, is formed by the union of the Kali and Trisuli rivers. After merging from this junction to the Indian border the river is called the Narayani. **The Gandak River,** is one of the major rivers **left bank tributary of the Ganges** in India. Its total catchment area amounts to 46,300 km^2, **most of it in Nepal. In the Nepal Himalayas, it is notable for its deep canyon.**

95. Solution: (b)

Exp) Option b is the correct answer.

Sukapaika river located in Odisha is one of the several **distributaries of the Mahanadi River.** Sukapaika's riverbed has suffered **massive erosion** and the surface of the river is witnessing unusually **high growth of hyacinth.** The river which stopped flowing 70 years ago in Odisha's Cuttack district is set to be rejuvenated now.

Statement 1 is incorrect: Sukapaika river is one of the **distributaries of the river Mahanadi**. It originates from Ayathur Village in **Cuttack district of Odisha (and not in Andhra Pradesh).** It branches away from the Mahanadi at Ayatpur village in Cuttack district and flows for about 40 kilometres before re-joining its parent river at Tarapur in the same district. In the process, it drains a large landmass comprising over hundreds of villages. So, statement 1 is incorrect.

Statement 2 is correct: The National Green Tribunal (NGT) has directed the Odisha government **to revive and rejuvenate a dead Sukapaika river in next six months** by earmarking a dedicated fund for the purpose. It is alleged that the river Sukapaika in Cuttack district became dead after its mouth was closed, restricting its free flow in the 1950s. The entire riverbed was **converted into a dumping ground for garbage and solid and liquid waste.** Some petitioners had moved the tribunal seeking its revival. The Odisha Government has started working on revival plans following a recent direction by NGT.

96. Solution: (a)

Exp) Option a is the correct answer.

Option 1, 2 and 3 are correct. The Narmada and Tapi rivers do not form deltas due to the **steep gradient** and **strong flow** of the rivers, which prevents sediment accumulation at their mouths, and the **rocky and uneven topography of the region.** Further they meet the Arabian Sea, where rivers create estuaries.

Option 4 is incorrect: This option is incorrect as large number of tributaries **increases the volume of water** which helps eroding and formation of sediments. This eventually is helpful in the formation of the delta.

97. Solution: (b)

Exp) Option b is the correct answer.

The Indus River System is one of the largest river basins of the world that is a part of the Himalayan River drainage system. It covers an area of 11,65,000 sq. km that has 321, 289 sq. km of its area in India. The total length of the river is 2,880 km with 1,114 km that lies in India.

Statement 1 is incorrect. The Indus River originates from a glacier near **Bokhar Chu** in the Tibetan region at an altitude of 4,164 m in the **Kailash Mountain range**. The Satluj river originates near Manasarovar from Rakshastal in the Tibetan Plateau.

Statement 2 is correct. The left bank tributaries of Indus are- Jhelum River (total length is 724 kms.), Chenab River (total length is 1,180 kms), Ravi River (total length 725 kms), Beas River (total length 460 kms), Sutlej River (total length 1,450 kms), Zanskar River (total length 338 km), Suru River (total length 185 km), Soan River (total length 250 km) etc. The **Right bank tributaries of the Indus River are-Shyok River (total length 550 km), Hunza River (total length 190 km), Gilgit River (total length 240 km), (total length 304 km), Gomal (total length 400 km) etc.**

Statement 3 is incorrect. The Indus River flows between the Ladakh and Zanskar ranges, it **cuts across the Ladakh range,** forming a spectacular gorge near Gilgit. The Chenab River flows parallel to Pir Panjal range through Pangi Valley and enters Jammu and Kashmir & cuts a deep gorge near Kishtwar.

98. Solution: (c)

Exp) Option c is the correct answer.

Narmada River is located in central India and the fifth longest river of India. The source of the Narmada is Narmada Kund located at Amarkantak in Anuppur District, Madhya Pradesh. It is one of the major rivers in India that run from east to west along with Tapti and the Mahi. It flows through the states of Madhya Pradesh (1,077 km), Maharashtra (74 km) and in Gujarat (161 km).

Statement 1 is correct: Narmada is the **longest west flowing river of the peninsular India**. Narmada flows westwards through a rift valley between the Vindhyan Range on the north and the Satpura Range on the south. Narmada basin extends over states of Madhya Pradesh, Gujarat, Maharashtra and Chhattisgarh having an area ~1 Lakh Sq.km.

Statement 2 is incorrect: Ajanta Caves is a series of rock-cut caves in the Sahyadri ranges (Western Ghats) situated on the **bank of Waghora river (not Narmada River) near Aurangabad in Maharashtra.** Important towns situated on the bank of Narmada rivers are Jabalpur, Barwaha, Hoshangabad, Harda, Narmada Nagar, Omkareshwar, Dewas (Nemavar, Kity, Pipri), Mandla and Maheshwar in Madhya Pradesh, and Rajpipla and Bharuch in Gujarat.

Statement 3 is correct: The major tributaries are the Hiran, the **Orsang, the Barna and the Kolar.**

Statement 4 is correct: The major Hydro Power Project and dams in the Narmada basin are Indira Sagar, Sardar Sarovar, Omkareshwar, Bargi & **Maheshwar.** The **Maheshwar dam is one of the large dams of the Narmada Valley Development Project**, which envisages the construction of 30 large and 135 smaller dams in the Narmada valley.

99. Solution: (c)

Exp) Option c is the correct answer.

The Peninsular drainage system is the oldest drainage system of India. The Western Ghats running close to the western coast act as the water divide between the major Peninsular rivers, discharging their water in the Bay of Bengal. Some of the major river systems of the Peninsular drainage are – the Mahanadi, the Godavari, the Krishna, the Kaveri etc.

Option 1 is incorrect. Sharavati River is a river in western **Karnataka state of southern India.** It rises in the Western Ghats and flows in a north-westerly direction to the **Arabian Sea.** Theriver falls to a depth of 253 meters forming the **highest waterfalls in India, the Jog Falls.** The major tributaries of the river are Nandihole, Haridravathi, Mavinahole, Hilkunji, Yennehole, Hurlihole, and Nagodihole. The **Mahatma Gandhi Hydroelectric Power Station** and the **Sharavati Valley Project,** situated on it, generate much of the electricity for Karnataka state.

Option 2 is incorrect. The **Bharathapuzha river** is the second longest **West Flowing River** that drains into the **Arabian Sea in Kerala** State. This basin is bounded in the East by the Cauvery basin, in the West by the Arabian Sea. Its drainage area is 6,186 sq.km spread over the two states namely **Tamil Nadu and Kerala**. 29% drainage area of river lies in Tamil Nadu whereas & 71% of it lies in Kerala.The Gayathripuzha, the Kalpathi Puzha and the Pulanthode, are the three important tributaries

Option 3 is correct. The **Pennar** is a peninsular river in south India that covers the states of **Andhra Pradesh and Karnataka**. It Rises in the Channakeshava hill of the Nandi Durga range, in Chikkaballapura district of Karnataka and flows towards east eventually **draining into the Bay of Bengal.** The total length of the river from origin to its outfall in the Bay of Bengal is 597 km. The principal tributaries of the river joining from left are the Jayamangali, the Kunderu and the Sagileru whereas the Chiravati, the Papagni and the Cheyyeru join it from the right.

Option 4 is correct. Brahmani River is a river in north-eastern **Odisha state of** India. It is formed by the confluence of the **Sankh and South Koel rivers** in southern Bihar state. It joins northern branches of the Mahanadi River, before emptying into the **Bay of Bengal** at **Palmyras Point**. It is one of the few rivers that cut across the Eastern Ghats, and forms a minor gorge at Rengali. The important tributaries of Brahmani are the Karo, the Shankh, and the Tirka.

100. Solution: (a)

Exp) Option a is the correct answer.

Luni is the river basin in Western Rajasthan, which forms the bulk of the arid zone. It originates from western slopes of the Aravalli ranges near Ajmer flowing in Southwest direction and traversing a course of 511 km in Rajasthan, and finally flows into the Rann of Kachchh.

Statement 1 is incorrect. Luni that originates from the Naga Hills of the Aravalli Range in Rajasthan's Ajmer district, **have freshwater** during the **first hundred kilometres** but as it reaches **Balotra in Barmer,** the water starts to turn saline from the rich salt content of the surface it flows on.

Statement 2 is incorrect. Luni river **does not drain in the Arabian Sea**, rather being a part of the inland drainage basin, **it ends in Barine**, located at the north-eastern part of the marsh called the Rann of Kutch in Gujarat, without flowing into any larger water body.

Statement 3 is incorrect. The major characteristic of the Luni River is that it tends to **increase its width rather than deepening the bed** because the banks are of soils, which are easily erodible whereas beds are of sand. Since the terrain is sandy, the river cannot cut a deep bed hence a wider channel is created as the river moves forward and when there is more water, the banks overflow instead of deepening the river bed. So wide and shallow the river becomes, that it can evaporate from the surface.

Statement 4 is correct. The main tributaries of Luni are the **Jawai, Sukri, Guhiya, Bandi (Hemawas) and Jojari rivers.** Jojari is the **only right-bank tributary** while its left bank has 10 tributaries. Also, it is the **only tributary** of the Luni River which **does not have its origin at Aravalli hill.**

101. Solution: (c)

Exp) Option c is the correct answer.

The river that crosses the tropic of cancer are- Sabarmati, **Mahi,** Kali Sindh (tributary of the Chambal River), Parbati (tributary of river Chambal), Ken, **Betwa, Son**, Damodar and Hugli.

102. Solution: (d)

Exp) Option d is the correct answer.

The Cauvery River originates from the **Brahmagiri hills** at an elevation of 1,341 metres in the **Kogadu district of**

Karnataka encompassing a drainage area of 81,155 square kilometres. The Cauvery basin extends across regions, with approximately **3 percent falling within Kerala, 41 percent in Karnataka, and 56 percent in Tamil Nadu**. Noteworthy tributaries contributing to its flow include the **Kabini, Bhavani, and Amravati rivers.**

Option d is correct: The Cauvery's catchment area receives rainfall from both the **Southwest monsoon (June-September) and the Northeast monsoon (October-December).** This ensures a continuous supply of water throughout the year, reducing the fluctuations in its flow compared **to other Peninsular rivers that only receive rainfall from one monsoon.**

Option a,b and c are incorrect: Like other Peninsular rivers the Cauvery River too has a **substantial number of human-made changes such as dams.** Additionally, the Cauvery River has a length of approximately **800 kilometres, which is not particularly short** compared to other Peninsular rivers. Furthermore, like other peninsular rivers, **Cauvery River too has an extensive network of non-perennial tributaries.**

103. Solution: (b)

Exp) Option b is the correct answer.

Option 1 is incorrect. Vamsadhara originates in Kalahandi district of Odisha. It finally joins the Bay of Bengal at Kalingapatnam, Andhra Pradesh. Water sharing of this river is a source of dispute between Andhra Pradesh and Odisha.

Option 2 and 3 are correct. The river Godavari is the largest of the peninsular rivers. **Pranhita** is the largest tributary of Godavari. Left Bank Tributaries of Godavari:

Banganga, Kadva, Shivana, Purna, Kadam, Pranahita, **Indravati**, Taliperu, Sabari, Dharna Right Bank Tributaries:

Nasardi, Pravara, Sindphana, Manjira, Manair, Kinnerasani

Option 4 is incorrect. The Pennar river rises in the Chenna Kasava hill of the Nandidurg range, in Chikkaballapura district of Karnataka and flows towards east eventually draining into the Bay of Bengal.

104. Solution: (a)

Exp) Option a is the correct answer.

The Brahmaputra River, also known as Yarlung Tsangpo in its upper reaches. It originates from the Chemyungdung glacier in Kailash Ranges of Himalayas in the Tibetan Plateau of China. It flows for over 2,900 km **through Tibet, India, and Bangladesh** before emptying into the Bay of Bengal.

Statement 1 is incorrect: The **Brahmaputra River originates from Mansarovar Lake near Chemayungdung glacier of the Kailash range, not Rakshastal Lake** (source of the Sutlej River). Both lakes are located near the Kailash range in the Tibetan.

Statement 2 is correct: The Brahmaputra River is known for its braided channels, which are formed by the deposition of sediments and the shifting of the river's course over time. These braided channels create a complex network of interconnected islands. The **world's largest riverine island, Majuli is located on the Brahmaputra River in Northeastern Assam.**

Statement 3 is incorrect: The **Dibang and Lohit rivers join the Brahmaputra after it enters India, not before.** These are major left bank tributaries of the Brahmaputra River system, contributing significantly to its flow and sediment load.

105. Solution: (b)

Exp) Option b is the correct answer.

A wetland is a distinct ecosystem where the **land is saturated or flooded with water, either permanently or seasonally.** This water can be fresh, saltwater, or a mix of both.

Pair 1 is incorrect: Keoladeo Ghana National Park is a **man made wetland** located in the Bharatpur district of Rajasthan. The wetland receives its **primary water supply from the Gambhir and Banganga rivers** (not Chambal river) which are held back on cultivated land through the use of an artificial dam known as Ajan Bund.

Pair 2 is incorrect: Ropar is a human made wetland located in modern day Punjab. It was formed in 1952 by the construction of a barrage for diversion of **water from the Sutlej River (not Beas)** for drinking and irrigation supplies. The site is an important breeding place for the nationally protected Smooth Indian Otter, Hog Deer, Sambar, and several reptiles, and the endangered Indian Pangolin (Manis crassicaudata) is thought to be present here.

Pair 3 is correct: Wular Lake is the 2nd largest fresh-water lake of Asia (first being Lake Baikal in Russia), situated on the foothills of Harmukh Mountain. The main source of water for **Wular Lake is River Jhelum.** Wular Lake is also said to be a remnant of Satisar Lake that existed in ancient times.

Pair 4 is correct: Chilika lake is located in the modern-day Odisha. **The main source of water for Chilika lake is Daya River** which forms the lake at its Bay of Bengal estuary. It is home to nearly 160 species of migratory birds in winter. In 1981, Chilika Lake was designated the **first Indian wetland of international importance under the Ramsar Convention.**

106. Solution: (d)

Exp) Option d is the correct answer.

The Godavari is the largest Peninsular River system. It is also called the Dakshin Ganga. Godavari River rises from Trimbakeshwar near Nasik in Maharashtra and flows for a length of about 1465 km before draining into the Bay of Bengal.

Salient Features of Godavari Basin

Basin Extent		
Longitude	73° 24' to 83° 4' E	
Latitude	16° 19' to 22° 34' N	
Total drainage area of the Basin	3,12,812 Sq.km	
State	Area in Sq.km	Percentage (%)
Maharashtra	152,199	48.66

ForumIAS

Telangana	62,150	19.87
Andhra Pradesh	11,048	3.53
Chhattisgarh	33,434	10.69
Madhya Pradesh	31,821	10.17
Odisha	17,752	5.67
Karnataka	4,405	1.41
Puducherry	3	0.001

A river is a flowing watercourse, while a river basin is the entire land area drained **by a river and its tributaries**, including the main river and its watershed.

Option d is correct: Godavari's River basin is spread over an area of 3.128 lakh sq. km. Godavari River basin is mainly spread across **Maharashtra (49%)**, **Telangana (19.9%)**, **Madhya Pradesh** (10%), **Chhattisgarh** (10%) and **Andhra Pradesh (3.5%).** Apart from them small portions of the river basin spread across the states of Odisha and Karnataka.

107. Solution: (a)

Exp) Option a is the correct answer.

The Ganga holds the utmost significance in India in terms of its basin and cultural importance. Originating near **Gaumukh (3,900 m)** in the **Uttarkashi district of Uttarakhand** from the **Gangotri glacier,** it is known as the **Bhagirathi** at this point. Significant tributaries, including the **Ramganga, Gomati, Ghaghara, Gandak, Kosi, and Mahanada**, contribute to the Ganga's flow. The river ultimately empties into the **Bay of Bengal near Sagar Island.**

Option 1 is incorrect- River Gandak, known as Kalie or Krishna Gandaki in the upper reaches, rises in the glacial of southern Tibet at altitude of 7,620 mt. near Tibet Nepal border to the southeast of Dhaulagiri. After receiving a number of tributaries like Mayangadi, Bari and Trisuli, Gandak debouches into the plains of West Champaran district of Bihar at Triveni (Valmikinagar). At this point two more tributaries viz. Panchand & Sarhad join the river. Thereafter, the river flows in a southerly direction and forms the boundary between Uttar Pradesh and Bihar for about 45 km. It then flows through Bihar and finally joins the River Ganga opposite Patna.

Option 2 is incorrect- Originating from the **Mapchachungo glaciers (Tibet)**, the **Ghagra river** is formed by the confluence of its tributaries—**the Tila, Seti, and Beri. Emerging near Shishapani**, it carves a **wide gorge.** As it progresses, the **Sarda River (also known as Kali or Kali Ganga)** joins it on **Option 3 is incorrect-** The primary stream of the **river Kosi**, known as the **Arun**, commences its journey in Tibet to the **north of Mount Everest**. The **Son Kosi**, originating from the west, and the **Tamur Kosi**, emerging from the **east,** merge with it after traversing **Nepal's Central Himalayas**. Upon joining forces with the river Arun, they collectively form the **Sapt Kosi.**

Option 4 is correct- Originating in the **Garhwal mountains** near **Gairsain (Uttarakhand), Ramganga** river alters its course **southwestward** after traversing the **Shiwalik**. Entering the plains of **Uttar Pradesh near Najibabad**, it ultimately meets the **Ganga** in the vicinity of **Kannauj.**

108. Solution: (b)

Exp) Option b is the correct answer.

The drainage area of India is divided into two parts based on the direction of flow of water: the Arabian Sea drainage and the Bay of Bengal drainage.

Statement I is correct: Indian drainage system may be divided on various bases. On the basis of **discharge of water (orientations to the sea),** it may be grouped into: (i) the Arabian Sea drainage; and (ii) the Bay of Bengal drainage. They are separated from each other through the Delhi ridge, the Aravalis and the Sahyadris. Nearly 77 per cent of the drainage area consisting of the Ganga, the Brahmaputra, the Mahanadi, the Krishna, etc. is oriented towards the Bay of Bengal (discharge their water in the Bay of Bengal) while 23 per cent comprising the Indus, the Narmada, the Tapi, the Mahi and the Periyar systems discharge their waters in the Arabian Sea.

Statement II is correct, but Statement-II is not the correct explanation for Statement-I: The Bay of Bengal drainage basin receives significant rainfall from two primary monsoons: the South-west monsoon and the northeast monsoon. The South-west monsoon, which occurs between June and September, is the primary source of rainfall for most of India, including the Bay of Bengal drainage basin. The North-east monsoon, which occurs between October and December, is a secondary source of rainfall for the region.

However, Statement II does not explain why most of the drainage area is oriented towards the Bay of Bengal. The **gradient or slope of the land in northern and eastern India generally tilts towards the southeast**, favoring the flow of water towards the Bay of Bengal. Hence majority of Indian rivers drain their water into Bay of Bengal.

109. Solution: (b)

Exp) Option b is the correct answer.

Hydroelectric projects on the Indus water system constitute a cornerstone of energy generation and water resource management for India. Recently, India and Pakistan attended the proceedings hosted by neutral experts on Indus Water Treaty to settle row over hydroelectric projects.

Pair 1 is correctly matched: The **Dulhasti Hydroelectric Project is situated on the Chenab River**, one of the major tributaries of the Indus River. It is in the Kishtwar district of Jammu and Kashmir. It is based on a concrete gravity dam.

Pair 2 is incorrectly matched: The Chamera Project is located on Ravi River and not Jhelum. It is in Himachal Pradesh.

Pair 3 is correctly matched: The Nathpa Jhakri Hydroelectric Project is situated on the Sutlej River in the Kinnaur district of Himachal Pradesh. The Nathpa Jhakri project has an installed capacity of 1,500 megawatts (MW), making it one of the largest hydroelectric power stations in India.

110. Solution: (b)

Exp) Option b is the correct answer.

Water covers 70% of our planet but only 3% of it are freshwater

and two-third of freshwater is tucked away in frozen glaciers or otherwise unavailable for our use.

As a result, some 1.1 billion people worldwide lack adequate access to water.

Peak water refers to a situation in which the supply of fresh water is not replenished at the rate it is consumed. This phenomenon signifies a precarious imbalance between demand and sustainable supply of water, posing a threat to ecosystems and human populations. As consumption patterns and population growth intensify, managing water resources becomes imperative to avert environmental degradation and ensure water security. The concept highlights the finite nature of available freshwater and underscores the need for responsible water management practices to address the challenges of growing demand and environmental sustainability.

Important Tips

Similar concepts:

Ecological Footprint: It is a measure of human impact on the environment, specifically the amount of natural resources required to sustain a particular lifestyle or activity. It calculates the area of land and water needed to produce the resources consumed by a population, absorb the waste generated, and provide space for infrastructure.

Carbon Footprint: It refers to the total amount of greenhouse gases, specifically carbon dioxide (CO2) and other carbon compounds, emitted directly or indirectly by human activities. These activities include burning fossil fuels for electricity, transportation, heating, manufacturing, and other purposes.

111. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is incorrect: The Ken-Betwa River linking project is a proposed project of interlinking of rivers in India that aims to **transfer water from the Ken River in Madhya Pradesh to the Betwa River in Uttar Pradesh.**

Statement 2 is correct: The **Ken-Betwa River linking project is the first project under the National Perspective Plan (NPP) for the interlinking of rivers (ILR),** which aims to address water scarcity and enhance irrigation across the country. The project involves building a dam, a canal, and several powerhouses, and has been approved by the Union Cabinet in 2021.

Statement 3 is correct: Daudhan Dam Complex is the key component of Phase 1 of the project and involves constructing a 77-meter-high dam across the Ken River.

Important Tips

National Perspective Plan for the interlinking of rivers:

1) It is a plan to develop water resources in India through inter-basin water transfer. The NPP was prepared in 1980 by the Ministry of Irrigation, now the Ministry of Jal Shakti.
2) The National Water Development Agency (NWDA) has been entrusted with the work of Interlinking of Rivers under the National Perspective Plan (NPP).
3) The NPP has two components, viz; Himalayan Rivers Development Component and Peninsular Rivers Development Component.

112. Solution: (b)

Exp) Option b is the correct answer

'The word "Zabo" means impoundment of water. "Zabo" is an indigenous farming system practiced largely in Phek district of Nagaland. Zabo is also known as "Dzüdü" or "Ruza" system in other parts of the district. It has a combination of forest, horticulture, agriculture, fishery and animal husbandry with well-founded soil and water conservation base on one hill. It has protected forest land towards the top of hill, water harvesting tanks in the middle and cattle yard and paddy fields beneath.

Rainwater that falls on forested hilltops is collected by channels that deposit the run-off water in pond-like structures created on the terraced hillsides. The channels also pass through cattle yards, collecting the dung and urine of animals, before ultimately meandering into paddy fields at the foot of the hill. Ponds created in the paddy field are then used to rear fish and foster the growth of medicinal plants.

Option a is incorrect. Jhalaras are typically rectangular-shaped stepwells that have tiered steps on three or four sides. These stepwells collect the subterranean seepage of an upstream reservoir or a lake. Jhalaras were built to ensure easy and regular supply of water for religious rites, royal ceremonies and community use.

Option c is incorrect. Integrated pest management, or IPM is an ecosystem-based strategy that focuses on long-term prevention of pests or their damage through a combination of techniques such as biological control, habitat manipulation, modification of cultural practices, and use of resistant varieties. Pesticides are used only after monitoring indicates they are needed according to established guidelines, and treatments are made with the goal of removing only the target organism. Pest control materials are selected and applied in a manner that minimizes risks to human health, beneficial and nontarget organisms, and the environment.

Option d is incorrect. Hydroponics farming techniques involve the growing of plants without soil, nourishing the plants through specialized nutrients that are added to water.

113. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is incorrect: Bhakra Nangal dam is located in the state of **Himachal Pradesh. It is built on the Sutlej River,** not the Ravi River as mentioned in the pair. **It is the highest gravity dam in India** and provides irrigation, hydroelectricity, and flood control benefits.

Pair 2 is correct: Situated in the state **of Odisha** in India, **Hirakud dam is built on the Mahanadi River**, as stated in

the pair. **It is the longest earthen dam in the world** and serves purposes like flood control, irrigation, and hydro-electric power generation.

Pair 3 is incorrect: Located in the state of Andhra Pradesh, Nagarjuna Sagar dam is constructed on the Krishna River, not the Godavari River as mentioned. **It is the world's largest masonry dam,** and one of the earliest multipurpose river valley projects in India, providing irrigation water to a vast area, hydroelectricity, and serves as a drinking water source.

Pair 4 is incorrect: Indira Sagar dam is on the Narmada River in Madhya Pradesh (not the Chambal River). It is a Multipurpose dam project and is a key component of the Narmada Valley Project and serves purposes like irrigation, hydro-electric power generation, and water supply. Its reservoir is among the largest of India.

114. Solution: (c)

Exp) Option c is the correct answer.

The **Jhelum River** is a river flowing through northwestern India and the northern and eastern regions of Pakistan. **It is a west flowing river that merges with the Indus River in Pakistan.** The total length of the Jhelum is about 450 miles (725 km).

Statement 1 is correct: Jhelum River originates from a spring called Verinag in the **Kashmir Valley.** The hydrology of the Jhelum River is largely controlled by **snowmelt from the Karakoram and Himalaya ranges** in the spring and the southwest monsoon on the Indian subcontinent that brings heavy rains from June to September.

Statement 2 is correct: The Jhelum River flows northwest from the **northern side of the Pir Panjal Range** through the **Kashmir Valley** to **Srinagar's Wular Lake.** The river then **flows out of the Wular Lake and flows further westwards.** Hence, the given statement is correct.

Statement 3 is incorrect: Though Jhelum is one of the prominent tributaries of the Indus River, it is **not the largest one.** The **Chenab is the largest tributary of the Indus.** It is formed by two streams, the Chandra and the Bhaga, which join at Tandi, in the Lahaul and Spiti district of Himachal Pradesh. **Sutlej is the longest tributary of the river Indus.** Hence, the statement given is incorrect.

Note:

1. **Largest tributary: It refers to the volume of water** it contributes to the main river. It refers to the tributary having the **highest average discharge** (amount of water flowing through a specific point over time) when compared to other tributaries of the same river system.
2. **Longest tributary:** It refers to the **linear distance** covered by the river from its source to its point of confluence with the main river. It essentially refers to the **physical length** of the tributary.

Statement 4 is correct: Nallah Lidder is biggest of all the streams that drains the mammoth contribution to the waters of Jhelum basin. The flow of this stream is from Shashnag and Tarsar Lake which join near Pahalgam Village and finally merges with river Jhelum at 2 Km downstream of Khannabal. The total area drained by this river is 580 Sq.Km after traversing a distance of 69 Km before its merger with Jhelum River.

115. Solution: (b)

Exp) Option b is the correct answer.

Option 1 is correct: Sabarmati River originates in the Aravalli Hills and meanders through Gujarat before emptying into the Gulf of Cambay, part of the Arabian Sea.

Option 2 is correct: Mahi Rising in the Satpura mountains of Madhya Pradesh, the Mahi traverses Maharashtra and Gujarat before merging with the Arabian Sea near Surat.

Option 3 is correct: Indus spanning Pakistan and India, originates in the Tibetan Plateau and flows southwestward, forming a vast Indus Delta that empties into the Arabian Sea south of Karachi.

Option 4 is incorrect: The Pennar rises in the Chenna Kasava hill of the Nandidurg range, in Chikkaballapura district of Karnataka and flows towards east eventually draining into the Bay of Bengal.

Option 5 is incorrect: The Vaigai is 258 kms long originates in the Western Ghats (Varushanad Hills) and finally empties into the Palk Strait near the Pamban Bridge in Ramanathapuram district.

116. Solution: (b)

Exp) Option b is the correct answer.

Wetlands are areas where **water covers the soil, or is present either at or near the surface of the soil** all year or for varying periods of time during the year.

Harike wetland is located at the confluence of the Beas and Sutlej rivers on the border between **Ferozepur and Amritsar district of Punjab,** covering approximately 86 square kilometres. It gained global recognition as a Ramsar site in 1990 due to its importance as a wetland and was established as a Wildlife Sanctuary in 1999.

Option a, c and d are incorrect: The confluence of -**Chenab & Ravi; Jhelum & Chenab and Sutlej & Ravi - occurs outside India,** whereas Harike wetland is situated in the State of Punjab.

117. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is incorrect: Jog Falls is located in the Shimoga district of Karnataka, India. It is the second-highest plunge waterfall in India and one of the highest in the world. **It is formed by the Sharvati River.** The Sharavati River originates in the Western Ghats and flows over a steep cliff known as Jogi gundi, which means "cobbler's abyss."

Pair 2 is incorrect: Sivasamudram Waterfall is also known as Shivanasamudra Falls. It is a waterfall formed by the Kaveri River in the Mandya district of Karnataka, India. Sivasamudram Waterfall is located on the Kaveri River, which originates in the Western Ghats and flows eastward across Karnataka and Tamil Nadu. The waterfall has two

distinct branches, known as the Gaganachukki Falls and Barachukki Falls.

Pair 3 is correct: Dhuandhar Waterfall is located on the Narmada River in Jabalpur, Madhya Pradesh, India. Dhuandhar Waterfall is formed by the Narmada River, which flows through a narrow gorge in the Marble Rocks. The name "Dhuandhar" means "smoke cascade" in Hindi, referring to the mist and spray that rises from the waterfall.

118. Solution: (d)

Exp) Option d is the correct answer.

Estuaries are semi-enclosed coastal bodies of water where freshwater from rivers meets and mixes with saltwater from the ocean. They are influenced by tidal fluctuations and serve as vital habitats for diverse marine and bird species. Deltas are depositional landforms formed at the mouths of rivers where sediment carried by the river is deposited. Deltas typically feature intricate networks of distributaries and are characterized by fertile soils, making them agriculturally productive areas.

Statement I is incorrect: Narmada and Tapi do not form deltas, but they do form estuaries.

Statement II is correct: Narmada and Tapi flow through rift valleys. These rivers cut through hard, rocky terrain of the rift valleys, which limits the amount of sediment they carry. Additionally, they maintain relatively high velocities, which prevents the deposition of sediment required for delta formation. As a result, the Narmada and Tapi rivers discharge directly into the Arabian Sea without forming deltas and thus instead form estuaries.

119. Solution: (b)

Exp) Option b is the correct answer.

The Cauvery River is unique in Peninsular India as it maintains a consistent flow of water throughout the year, experiencing relatively minimal fluctuations compared to other rivers in the region. This is because the upper catchment area receiving rainfall during the southwest monsoon season (summer) and the lower part receiving rainfall during the northeast monsoon season (winter).

Options 2,3,5 and 6 are correct: The Cauvery River originates from Talakaveri in the Western Ghats of Karnataka and flows for approximately 800 kilometres before emptying into the Bay of Bengal. It is fed by 21 major tributaries, each with a catchment area of over 250 square kilometres. Some of the largest tributaries include the Shimsha, Amaravathi, Kabini, and Bhavani.

The Cauvery basin extends over states of Tamil Nadu, Karnataka, Kerala and Union Territory of Puducherry draining an area of 81,155 Sq.km which is nearly 2.7% of the total geographical area of the country. The basin spreads over 33 parliamentary constituencies (2009) comprising **18 of Tamil Nadu, 11 of Karnataka, 3 of Kerala and 1 of Puducherry.**

It is to be noted here that a **river is a stream of water that flows from high mountains to lowland** and into another river, sea or ocean. On the other hand, **a river basin is the portion of land in which snow and rainfall collect and flow into a river,** thus made up of many different watersheds.

Option 1 and 4 are incorrect: The Cauvery River basin **does not cover the States of Maharashtra and Andhra Pradesh.**

120. Solution: (d)

Exp) Option d is the correct answer.

The **Brahmani River delta is the site of the Bhitarkanika Wildlife Sanctuary**, renowned for its estuarine crocodiles. The Brahmani River is a river in eastern India that flows through **the state of Odisha.** It is formed by the confluence of the Sankh and South Koel rivers near Rourkela and joins the Bay of Bengal near Chandbali. It is the second widest river in Odisha after the Mahanadi and forms a large delta with the Baitarani River.

Bhitarkanika National Park and Wildlife Sanctuary is inundated by the rivers **Brahmani, Baitarani, Dhamra, and Pathsala.** It is the second-largest mangrove ecosystem in India and hosts many species of flora and fauna, including the endangered saltwater crocodiles.

Important Tips

Chambal river: This river flows through the states of Madhya Pradesh, Rajasthan and Uttar Pradesh. It joins the Yamuna River near Sahon, Bhind.

Son river: This river is a major tributary of the Ganges River, originating near Amarkantak Hill in Pendra, Chhattisgarh.

Damodar river: This river flows across the states of Jharkhand and West Bengal. It originates from the Khamarpat Hill on Chotanagpur Plateau in Palamau district, Jharkhand. It joins the Hooghly River near Howrah

121. Solution: (d)

Exp) Option d is the correct answer.

The correct order of the rivers from north to south:

Option 3: Subarnarekha River flows through the states of **Jharkhand, West Bengal and Odisha, and joins the Bay of Bengal** near Kirtania port. It is 395 km long and has a drainage basin of 18,951 sq km. It is named Subarnarekha, meaning "streak of gold", because of the gold deposits found near its origin at Piska village in Ranchi district.

Option 1: Wainganga River originates in the Mahadeo Hills in **Seoni district of Madhya Pradesh, and flows south through the states of Madhya Pradesh and Maharashtra,** before joining the Pranahita River, a tributary of the Godavari. It is 580 km long and has a drainage basin of 43,658 sq km.

Option 4: Penner River rises in the Nandidurg Hills in Chikkaballapur district of Karnataka, and flows north and east through the **states of Karnataka and Andhra Pradesh,** before emptying into the Bay of Bengal near Nellore. It is 597 km long and has a drainage basin of 55,213 sq km. It is also known as Uttar Pinakini, meaning "northern bow", because of its curved course.

Option 2: Vaigai River originates in the Varusanadu Hills of the **Western Ghats in Theni district of Tamil Nadu**, and flows southeast through the state of Tamil Nadu, before joining the Palk Bay near Alagankulam. It is 258 km long and has a drainage basin of 7,121 sq km.

122. Solution: (c)

Exp) Option c is the correct answer.

Irrigation projects and dams play a crucial role in India's water management, power generation, and agricultural productivity. They regulate river flow, provide water for irrigation, support hydroelectric power production, and aid in flood control.

Row 1 is incorrect. The Rihand Dam is not located in Jammu and Kashmir rather it is situated in **Uttar Pradesh.** It is built on the **Rihand River,** which is a tributary of the Son River. The Rihand Dam is the largest man made reservoir in India, known as **Govind Ballabh Pant Sagar.**

Row 2 is correct. The Tehri Dam, one of the tallest dams in the world, is located in **Uttarakhand** and is built on the **confluence of Bhagirathi and Bhilganga River.** It is a multipurpose dam, providing irrigation, municipal water supply, and hydroelectricity.

Row 3 is correct. The Nagarjuna Sagar Dam is located on the **Krishna River,** in the state of **Telangana.** It was one of the earliest major irrigation and hydroelectric projects initiated after India's independence. The dam plays a vital role in irrigation and drinking water supply in the region.

Row 4 is correct. The Hirakud Dam is situated in **Odisha on the Mahanadi River.** It is the longest earthen dam in the world, built primarily for flood control, irrigation, and hydroelectric power production. It was constructed post-independence and has significantly improved agricultural output in Odisha and Chhattisgarh.

123. Solution: (c)

Exp) Option c is the correct answer.

River linking projects in India aim to transfer surplus water from one basin to another to address regional water imbalances, irrigation shortages, and drinking water needs. These projects are managed by the National Water Development Agency (NWDA).

Option a is incorrect. The Par-Tapi-Narmada (PTN) link project, part of India's National Perspective Plan, aims to transfer water from the water-surplus regions of the Western Ghats to the water-deficit regions of Kutch and Saurashtra in Gujarat by linking the Par, Tapi, and Narmada rivers.

Option b is incorrect. The **Godavari (Inchampalli)-Cauvery (Grand Anicut) link project:** It envisages, as its first part, the diversion of surplus flows of the Mahanadi to the Godavari system and further transfer along with the surplus water from Godavari system to the Krishna, Pennar, Cauvery, Vaigai and Gundar basins through the ninelink system.

Option c is correct. The **Ken-Betwa Link Project (KBLP) is the first river-linking project under India's National Perspective Plan (NPP).** It is designed to transfer surplus water from the Ken River (Madhya Pradesh) to the Betwa River (Uttar Pradesh) to address water scarcity in the Bundelkhand region.

1. Daudhan Dam: A **77-meter high dam** across the **Ken River** to store and regulate water flow.

2. Lower Orr Dam & Kotha Barrage: Additional storage and water management structures to **optimize water distribution** in the Betwa Basin.

Option d is incorrect. The Mahanadi Godavari Link Project envisages construction of a storage reservoir on Mahanadi River at Manibhadra and a link canal from this reservoir to the Godavari River.

124. Solution: (d)

Exp) Option d is the correct answer.

The river being described in the passage is the **Ghaghara River**, which is a major tributary of the **Ganga River**.

1. **Origin:** The **Ghaghara River originates** near Gurla Mandhota peak, south of Mansarovar lake and flows through Nepal before entering India via **Uttarakhand**.
2. **Tributaries:** One of its significant tributaries is the **Sarda River**, along with others like the Rapti river.
3. **Confluence:** It eventually merges with the **Ganga River** in Bihar.

Option a is incorrect: Gomati River originates in **Uttar Pradesh**, not Tibet.

Option b is incorrect: Kosi River originates in **Nepal**, not Tibet, and is known as the "Sorrow of Bihar" due to frequent floods.

Option c is incorrect: Gandak River originates in **Nepal** and is another important tributary of the Ganga.

125. Solution: (a)

Exp) Option a is the correct answer.

The correct sequence of these rivers from **west to east** is **Chambal → Sind → Betwa → Ken → Son.** These rivers are part of the **northern Peninsular river system** and mostly flow **north or northeast**, eventually joining either the **Yamuna or the Ganga.**

1. The **Chambal River**, originating from **Janapav Hills (Madhya Pradesh, Vindhya Range)**, is a major tributary of the Yamuna and flows through **Madhya Pradesh, Rajasthan, and Uttar Pradesh.**
2. The **Sind River** originates in **Madhya Pradesh** and joins the Yamuna in **Uttar Pradesh**, passing through the **Bundelkhand region**, known for its rocky terrain and semi-arid conditions.
3. The **Betwa River**, rising near **Bhopal, Madhya Pradesh**, also flows northeast to meet the Yamuna in **Uttar Pradesh.**

4. The **Ken River**, originating in **Madhya Pradesh**, flows through **Panna Tiger Reserve** before meeting the Yamuna in **Uttar Pradesh**.

126. Solution: (c)

Exp) Option c is the correct answer.

The **Beas River is the only river among the given options that joins the Sutlej directly**. It merges with the Sutlej River at Harike in Punjab before the Sutlej enters Pakistan.

The **Satluj River** has a total length of **1,450 km**, out of which **1,050 km** flows within **India**. It originates from the **Rakas Lake**, located near **Lake Manasarovar** in **Tibet**, at an altitude of about **4,570 meters**. Once the **Satluj River** reaches the **Punjab Plains**, it enters at **Rupnagar (Ropar)** and then turns **westward**, where it is joined by the **Beas River** at **Harike**.

Further downstream, the **Ravi, Chenab, and Jhelum Rivers** collectively drain into the Satluj before it finally joins the **Indus River** a few kilometres above **Mithankot** in **Pakistan**.

127. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is incorrect. Bengaluru is **not** located on the banks of the **Krishna River**. Instead it is located on the banks of the **Vrishabhavathi River and the Dakshina Pinakini River** (also known as the Ponnaiyar River).

Pair 2 is correct. Surat, a major commercial and textile hub of Gujarat, is located on the **banks of the Tapi (Tapti) River**. The Tapi River, originating from the Satpura range in Madhya Pradesh, flows westward into the Arabian Sea near Surat. The river plays a significant role in Surat's economy, supporting industries, agriculture, and port activities.

Pair 3 is incorrect. Hyderabad is not located on the Godavari River. Instead, it is situated on the banks of the **Musi River**, a tributary of the Krishna River. The Musi River played a crucial role in Hyderabad's establishment and growth, with several historic structures like the Charminar and Golconda Fort located near its banks.

Pair 4 is incorrect. Jodhpur is located in the arid region of Rajasthan. It is **not located** on the banks of the Banas River. The **Banas River flows through Rajasthan**, but it is primarily associated with **Udaipur, Tonk, and Sawai Madhopur regions**.

128. Solution: (c)

Exp) Option c is the correct answer.

Teesta River is a 414 km long river that rises in the **Pauhunri Mountain of eastern Himalayas.**The Teesta is the **largest river of Sikkim and second largest river of West Bengal** after the Ganges.

Statement 1 is correct: Teesta River originates from the **Tso Lhamo Lake in the eastern Himalayas of Sikkim, near the India-China border.**It flows southward through Sikkim and West Bengal before entering Bangladesh, where it merges with the Brahmaputra River (Jamuna).

Statement 2 is incorrect: The Tista River flows **only through Sikkim and West Bengal before entering Bangladesh.It does not flow through Assam. The river joins Brahmaputra in Bangladesh.**

Statement 3 is correct: Jalpaiguri town of West Bengal is situated on the banks of Teesta River

129. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct. River Mahi is the only river in India that crosses the Tropic of Cancer twice. The Mahi River originates in the Vindhya Mountains in Madhya Pradesh. It flows northwest through Madhya Pradesh, crossing the Tropic of Cancer. It then flows southwest through Gujarat, crossing the Tropic of Cancer again. The Mahi River eventually flows into the Arabian Sea by the Gulf of Khambhat.

Statement 2 is correct. Luni is the only river in India that flows into the Rann of Kutch. The Luni originates in the Aravalli Hills in Rajasthan.It flows through Rajasthan and eventually empties into the Rann of Kutch.

Statement 3 is incorrect. Tapi is not the only river that flows through rift valley. Narmada also flows through rift valley.

They flow from east to west direction. This exceptional behaviour is because these rivers didn't form valleys and instead they flow through faults (linear rift, rift valley, trough) created due to the bending of the northern peninsula during the formation process of Himalayas.

Also, Damodar which occupies the eastern margins of the Chotanagpur Plateau flows through a rift valley.

130. Solution: (b)

Exp) Option b is the correct answer.

Kaveri (Cauvery) is the most revered and sacred river of south India and is designated as the 'Dakshina Ganga' or the Ganga of the South. **Cauvery River basin** extends across the states of **Karnataka, Kerala, and Tamil Nadu**.

Option 1 is correct: The **Cauvery River originates** from **Talakaveri in the Western Ghats (Kodagu district, Karnataka)** and flows extensively through the state.

Option 2 is correct: Some tributaries of the Cauvery, such as **Kabini and Bhavani**, originate in Kerala and contribute to the river's flow.

Option 3 is correct: The river **enters Tamil Nadu**, where it serves as a **major water source** before finally **draining into the Bay of Bengal**.

Option 4 and 5 are incorrect: Andhra Pradesh and Telangana states are not part of the Cauvery River basin.

131. Solution: (b)

Exp) Option b is the correct answer.

Row 1 is correctly matched: Kunchikal Falls is the highest waterfall in India. It is located in the Western Ghats of Karnataka, Karnataka's Shimoga district and is formed by the Varahi River.

Row 2 is correctly matched: Dudh Sagar Falls knis own for its spectacular four-tiered cascade, with a total height of about 310 meters (1,017 feet). It is located on the **Mandovi River. It is located in Goa.**

Row 3 is incorrectly matched: Barehipani Falls is the second-highest waterfall in India, with a total height of 399 meters (1,309 feet). It **is situated in the Mayurbhanj district of Odisha**, within the Simlipal National Park, which is part of the Simlipal Hills. **The waterfall is formed by the Budhabalanga River**, which originates in the Simlipal Hills and eventually merges into the Bay of Bengal.

Jog falls is formed by Shravati river.

132. Solution: (a)

Exp) Option a is the correct answer.

Kabini, Bhavani and Amravati are the principal tributaries of the Kaveri river. The Kaveri rises in Brahmagiri hills of Kogadu district in Karnataka. Since the upper catchment area receives rainfall during the southwest monsoon season (summer) and the lower part during the northeast monsoon season (winter), the river carries water throughout the year with comparatively less fluctuation than the other Peninsular rivers. About 3 per cent of the Kaveri basin falls in Kerala, 41 per cent in Karnataka and 56 per cent in Tamil Nadu.

133. Solution: (a)

Exp) Option a is the correct answer.

Row 1 is correct: The Godavari, also known as Dakshin Ganga, is the largest Peninsular river system. It **rises in the Nasik district of Maharashtra and discharges its water into the Bay of Bengal.** Its tributaries run through the states of **Maharashtra, Madhya Pradesh, Chhattisgarh, Odisha and Andhra Pradesh.** The **Penganga,** the Indravati, the Pranhita, and the Manjra are its principal tributaries. The Godavari is navigable only in the deltaic stretch.

Row 2 is incorrect: The **Krishna** is the second largest east-flowing Peninsular river which **rises near Mahabaleshwar in Sahyadri.** The **Koyna, the Tungbhadra and the Bhima are its major tributaries.** Of the total catchment area of the Krishna, 27 per cent lies in **Maharashtra,** 44 per cent in **Karnataka** and 29 per cent in **Andhra Pradesh** and **Telangana.**

The Kaveri river rises in Brahmagiri hills of Kogadu district in Karnataka.

Indravati river is tributary of Godavari river.

Row 3 is incorrect: The **Mahanadi rises near Sihawa in Raipur district of Chhattisgarh** and runs through Odisha to discharge its water into the Bay of Bengal. Some navigation is carried on in the lower course of this river. Fifty-three per cent of the drainage basin of this river lies in **Madhya Pradesh** and **Chhattisgarh,** while 47 per cent lies in **Odisha.**

The Narmada originates on the western flank of the Amarkantak plateau at a height of about 1,057 m. Kolar river is a tributary of Narmada river.

134. Solution: (c)

Exp) Option c is the correct answer.

The **Ganga River**, one of the most significant rivers in India, originates from the **Gangotri glacier near Gaumukh (3,900 m)** in the **Uttarkashi district of Uttarakhand**. In its upper course, it is known as the **Bhagirathi** and flows through narrow gorges in the **Central and Lesser Himalayas**. At **Devprayag**, it meets the **Alaknanda River**, and from this confluence onward, it is called the **Ganga**. As the river progresses into the plains, it is joined by several important tributaries from both the north and south.

When considering the tributaries from **west to east, the correct sequence is:**

1. **Ramganga River** – It originates in the **Garhwal hills** near Gairsain in **Uttarakhand**. After crossing the Shiwalik range, it changes its course to the southwest direction and enters the plains of Uttar Pradesh near Najibabad. Eventually, it **joins the Ganga near Kannauj.**
2. **Gomati River** – It originates in **Pilibhit district, Uttar Pradesh**, and flows southeastward, passing through Lucknow, before merging with the **Ganga in Gazhipur district.**
3. **Ghaghara River** – This river originates from **glaciers in Mapchachungo, Tibet**. As it flows downward, it gathers water from its tributaries Tila, Seti, and Beri. It then cuts a deep gorge at Shishapani, before entering the plains. In the plains, the Sarda (Kali or Kali Ganga) River joins it before it finally **meets the Ganga at Chhapra in Bihar**.
4. **Gandak River** – It is formed by two streams: Kaligandak and Trishulganga. It **rises in the Nepal Himalayas**, between the Dhaulagiri and Mount Everest, draining the central part of Nepal. It enters the Ganga plains in Champaran district of Bihar and eventually **merges with the Ganga at Sonpur near Patna.**

Thus, moving from west to east, the correct sequence of tributaries is **Ramganga → Gomati → Ghaghara → Gandak**.

135. Solution: (a)

Exp) Option a is the correct answer.

The river described in the question is the **Jhelum River,** one of the important tributaries of the Indus River system. Jhelum originates from a **spring at Verinag, located at the foot of the Pir Panjal range in Jammu and Kashmir.** Verinag is a well-known tourist attraction and a historical site with a beautifully constructed Mughal Garden. The river flows through Srinagar, the summer capital of Jammu and Kashmir. Along its course, it p**asses through the Wular Lake, which is the largest freshwater lake in India.** After passing through the Kashmir Valley, the Jhelum River flows into Pakistan, where it eventually merges with the Chenab River, which further joins the Indus River.

Option b is incorrect: The **Chenab River** is a major tributary of the Indus. It originates from near the **Baralacha Pass in Himachal Pradesh** and flows through **Jammu and Kashmir** before entering **Pakistan.**

Option c is incorrect: The Ravi River originates from the Kullu Hills in Himachal Pradesh and flows through India and Pakistan before merging with the Chenab River.

Option d is incorrect: The Beas River originates from Beas Kund in Himachal Pradesh and flows through Himachal Pradesh and Punjab, eventually joining the Sutlej River.

136. Solution: (a)

Exp) Option a is the correct answer.

The Brahmaputra River flows only through the states of Arunachal Pradesh and Assam in India.

1. The Brahmaputra River originates from the **Chemayungdung glacier of the Kailash range near Mansarovar Lake** and flows eastward for about 1,200 km in Tibet, where it is known as the **Tsangpo**. It enters India through **Arunachal Pradesh**, near Sadiya, here it is locally known as the **Siang or Dihang River**. After receiving tributaries such as the Dibang and Lohit, it takes the name Brahmaputra in Assam.
2. Flowing for approximately 750 km through **Assam,** the river is fed by several tributaries. Major left-bank tributaries include the Burhi Dihing and Dhansari, while the right-bank tributaries consist of the Subansiri, Kameng, Manas, and Sankosh rivers.
3. It then **enters Bangladesh near Dhubri**, where the Tista River joins it. From this point, it is referred to as the **Jamuna**. Eventually, the Brahmaputra merges with the Padma River, which drains into the Bay of Bengal.

137. Solution: (a)

Exp) Option a is the correct answer.

Kodaikanal Lake is a manmade lake located in the Kodaikanal city in Dindigul district in Tamil Nadu. Sir Vere Henry Levinge, the then Collector of Madurai, was instrumental in creating the lake in 1863, amidst the Kodaikanal town which was developed by the British and early missionaries from USA.

138. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct: Aadi Perukku is a distinctive event and a remarkable festival of Tamil Nadu. In this Mother Nature is worshipped by the people of state in the form of Amman deities. **They also express gratitude to the river Kaveri during this time.** It is to thank nature for showering its grace, peace and prosperity. In this, people worship lakes and all perennial river sources of the state.

Statement 2 is correct: Kerala's famous Sabarimala temple is well known for the Mandala-Makaravilakku (Makar Sankranti) festival, which lasts for almost two months. It is celebrated in The Lord Ayyappa temple at Sabarimala. **Sabarimala temple dedicated to Lord Ayyappa is located on the banks of the river Pamba.**

Statement 3 is correct; Kumbh Mela is the largest Hindu fair held in India. It is held every fourth year at four different places. - the banks of the Godavari River in Nashik, the Ganga River in Haridwar, the **Shipra (Kshipra) River in Ujjain,** and at confluence of the Ganges, Yamuna and Saraswati in Allahabad (now known as Prayagraj).

139. Solution: (c)

Exp) Option c is the correct answer.

The Brahmaputra River is also known as Yarlung Zangbo in China. It originates from the glacier mass of the Kailash Range of the Himalayas.

Statement 1 is incorrect: Its principal right bank tributaries are the Kameng River, Manas River, Beki River, Raidak River, Jaldhaka River, Teesta River, Subansiri River whereas the principal left bank tributaries are Lhasa River, Nyang River, Parlung Zangbo, Lohit River, Dhansiri River, Kolong River.

Statement 2 is incorrect: The **major part of basin is covered with forest areas which accounts to 55.48% of the total area whereas 5.79% of the basin is covered by water bodies.**

Statement 3 is correct: Six tributaries of Brahmaputra River are namely the Tista, the Sankosh, the Raidak-I, the Raidak-II, the Torsa and the **Jaldhaka** which flows through the northern part of West Bengal. **Jaldhaka join the main stream of Brahmaputra but, in the plains of Bangladesh.**

Jaldhaka River' one of the trans-boundary rivers, originates from the Himalayas of southeast Sikkim and flows over Jalpaiguri and Kuch Bihar. The river enters Bangladesh through Lalmonirhat district. After entering Bangladesh, the river joins with the Dharla and flows as Dharla before debouching into the Brahmaputra near Kurigram.

140. Solution: (d)

Exp) Option d is the correct answer.

Inland drainage basin is formed by rivers pouring their waters in a lake or an inland sea. Inland Drainage Basin Rivers do not enter a sea or ocean. They are found in different parts of North and South India.

Statements 1, 2 and 5 are correct: Area of Inland drainage in Rajasthan extends over states of Haryana and Rajasthan. Small rivers which form inland drainage are named as the **Kantu, the Kakni, the Ghugri and the Sukri.**

Statement 3 is incorrect: The **Sabarmati River** which is originated in Rajasthan and flows through Gujarat State before **entering into the Gulf of Khambhat in the Arabian Sea. It** is not an inland drainage basin. It is **Luni River** which is located in western Rajasthan. It starts its journey from the Pushkar valley of the Aravalli ranges and moves through Thar desert to disappears into the marshy lands of Rann of Kutch, Gujarat.

Statement 4 is correct: **Ghaggar River** is also an inland drainage basin river. It **originates from the Shivalik hills of Himachal Pradesh** at an elevation of about 1,927 meters above mean sea level. It flows through Indian states of Punjab and Haryana to at last enter into Rajasthan.

141. Solution: (b)

Exp) Option b is the correct answer.

The Brahmaputra rises in Tibet east of Mansarowar lake very close to the sources of the Indus and the Satluj. It is

slightly longer than the Indus, and most of its course lies outside India. It flows eastwards parallel to the Himalayas. On reaching the Namcha Barwa (7757 m), it takes a 'U' turn and enters India in Arunachal Pradesh through a gorge.

An important geomorphotectonic character of the Himalayas is the **sharp bending of the Himalayas and the associated mountain ranges**, which at the western end join with the Sulaiman and Kirthar Ranges in the southwestern end. There is a similar sharp bending at the eastern end, where the mountain range joins the north-trending Indo-Myanmar Range, represented by the Naga Hills and the Arakan Yoma. These **two sharp bends on either side of the mountain range are popularly known as the 'Syntaxial bends' of the Himalayan Mountain Range. This bend at the eastern end is responsible for the 'U-turn of Brahmaputra River.**

142. Solution: (c)

Exp) Option c is the correct answer.

The correct sequence of the rivers from North-South is given below

4. **Ambika River** is one of the important west flowing rivers with its catchment in Gujarat and Maharashtra. It originates from Saputara Hill ranges near village Kotambi of Surgana taluka in the Nasik district of Maharashtra. After flowing for a length of 136 km it drains in to the Arabian Sea.
3. **The Kajavi River** is a west flowing river which rises in the Vishalghat region of Sahyadri hills and flows West ward and joins the Arabian Sea near Ratnagiri port, Maharashtra. It forms a 10 km. long creak named Bhatya Creak has been formed.
2. **The Mandovi River** is one of the main West Flowing Rivers of Goa State. The river runs in the North- East direction for about 5 km and then follows in the West ward direction.
1. **The Kali Nadi** is a west flowing river. The river originates near Kushavali, a small village in Uttar Kannada district. It further flows through Uttara Kannada district of Karnataka state.

143. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct.

The west flowing rivers of the Peninsular India are fewer and smaller as compared to their east flowing counterparts. The two major west flowing rivers are the Narmada and the Tapi. This exceptional behaviour is because these **rivers flow through faults** (linear rift, rift valley, trough) **created due to the bending of the northern peninsula** during the formation process of Himalayas.

Statement 2 is incorrect.

Though Narmada River flows between the Vindhyas and the Satpuras, it is **not the correct reason** for westward flow of Narmada River.

Statement 3 is incorrect.

The land slopes to the east in the region and not west from Central India. The slopes of central highlands are from south west to north east.

144. Solution: (b)

Exp) Option b is the correct answer.

Arunachal Pradesh is situated in the north eastern part of India is 83,743 sq km in area and has a long international border with Bhutan to the west (160 km), China to the north and north-east (1,080 km) and Myanmar to the east (440 km). Arunachal Pradesh criss-crossed by numerous rivers, riverine and streams in true sense is a land of rivers. The prominent rivers flowing through this Himalayan state are:

1. **Brahmaputra:** The 2,900-km long **Brahmaputra**, major river of the state, is known for transport, irrigation and potable water source.
2. **Siang River**: It is major tributary of Brahmaputra, provides enough opportunities for adventure sports, like tubing, fishing and trekking.
3. **Subansiri River**: Emerging from the Himalayas is the biggest tributary of the Brahmaputra River.
4. **Lohit River**: It rises from Zayal Chu range of eastern Tibet and flows 200-km in Arunachal Pradesh criss-crossing Lohit and Namsi districts.

The **Barak River** flows 900 kilometres through the states of **Manipur, Nagaland, Mizoram and Assam** in India. Further it enters Bangladesh where it is known by the name of the Surma.

5.3. Indian Climate

145. Solution: (b)

Exp) Option b is the correct answer.

The most widely used classification of climate is the empirical climate classification scheme developed by V. Koeppen. Koeppen identified a close relationship between the distribution of vegetation and climate. It is an empirical classification based on mean annual and mean monthly temperature and precipitation data. He introduced the use of capital and small letters to designate climatic groups and types. Koeppen's scheme is still popular and in use.

Major climate types according to Koeppan are as follows:

Group	*Type*	*Letter Code*	*Characteristics*
A-Tropical Humid Climate	Tropical wet	Af	No dry season
	Tropical monsoon	Am	Monsoonal, short dry season
	Tropical wet and dry	Aw	Winter dry season
B-Dry Climate	Subtropical steppe	BSh	Low-latitude semi arid or dry
	Subtropical desert	BWh	Low-latitude arid or dry
	Mid-latitude steppe	BSk	Mid-latitude semi arid or dry
	Mid-latitude desert	BWk	Mid-latitude arid or dry
C-Warm temperate (Mid-latitude) Climates	Humid subtropical	Cfa	No dry season, warm summer
	Mediterranean	Cs	Dry hot summer
	Marine west coast	Cfb	No dry season, warm and cool summer
D-Cold Snow-forest Climates	Humid continental	Df	No dry season, severe winter
	Subarctic	Dw	Winter dry and very severe
E-Cold Climates	Tundra	ET	No true summer
	Polar ice cap	EF	Perennial ice
H-Highland	Highland	H	Highland with snow cover

Thus, Hot desert climates are denoted as BWh and are typically found under the subtropical ridge in the lower

middle latitudes or the subtropics, often between 20° and 33° north and south latitudes. In these locations, stable descending air and high pressure aloft clear clouds and create hot, arid conditions with intense sunshine.

146. Solution: (b)

Exp) Option b is the correct answer.

'Advective' and 'Radiation', two different forms of fog in India generally form in the sub tropics, around latitude 25°. The former category of fog forms in the coastal areas due to constant moisture feed from the water bodies and the latter forms on a humid night with clear skies, after the passage of a Western Disturbance.

Factors responsible for fog in different regions in India:

Statement 1 is correct: Dense fog in Delhi and North India (from December till the end of January) is the most common feature of the winter season which leads to massive delays and cancellations of flights and trains. **The reason for fog in North India is because of a weather system called Western Disturbance.** A Western Disturbance affecting the hills of Jammu and Kashmir may sometimes lead to a sudden reversal of winds from the normal dry and cool northwesterly to humid easterlies or southeasterlies which could cause widespread fog in the plains of North India.

Statement 2 is incorrect: Light variable or calm winds (speed below 5kmph) do not allow fog to lift and lead to further continuation of fog for a longer duration. Whereas high variability in the wind speed helps in clearing the foggy skies.

Statement 3 is correct: Fog in East India has also been very thick and dense causing major flight and rail delays. However, the reason for fog formation in this part of the country is primarily due to its proximity to water bodies (River Ganga) and slow wind speed.

Statement 4 is correct: Many studies in the past have identified PM2.5 (particulate matter or aerosol particles with a diameter of fewer than 2.5 micrometres) as a major pollutant, responsible for haze and fog formation over Indo-Gangetic plains including Delhi. The recent study explains that complex chemical reactions involving Hydrochloric Acid (HCl), which is directly emitted into the atmosphere from the burning of plastic waste and from a few industrial processes, are primarily responsible for high PM2.5 chloride and the subsequent haze and fog formation over Delhi during chilly winter nights.

Important Tips

In the hilly areas of the Northeast, characteristics of fog are completely different from what they are in the plains of East India. The terrain of Northeast India is a mix of everything, from hills and valleys to mountains, which is conducive for trapping fog for longer durations. **Northeast is well known for dense fog throughout the winter season due to persistent flow of moist air from River Brahmaputra.**

147. Solution: (b)

Exp) Option b is the correct answer.

The average annual rainfall in India is about 125 cm, but it has great spatial variations. The monsoon rainfall has a declining trend with increasing distance from the sea. Kolkata receives 119 cm during the southwest monsoon period, Patna 105 cm, Allahabad 76 cm and Delhi 56 cm.

Statement 1 is correct, but Statement 2 is incorrect: The rain which comes in spells, **displays a declining trend from west to east over the west coast, and from the southeast towards the northwest over the North Indian Plain** and the northern part of the Peninsula.

Monsoonal rainfall is largely governed by relief or topography. For instance the windward side of the Western Ghats register a rainfall of over 250 cm. Again, the heavy rainfall in the north-eastern states can be attributed to their hill ranges and the Eastern Himalayas.

Statement 3 is correct: South-eastern districts viz. Pratapgarh, Banswara, Jhalawar, Baran and Sirohi receive highest rainfall over other districts during all the months and seasons in Rajasthan. These districts get the rain when the Bengal branch of the south-west Monsson current is trapped by the Aravallis.

148. Solution: (a)

Exp) Option a is the correct answer.

Local winds occur on a small spatial scale. They also tend to be short-lived lasting typically several hours to a day. There are many such winds around the world, some of them cold, some warm, some wet, some dry. Few of the popular winds in India and the world are discussed below:

Statement 1 is correct: Black storms, locally called Kali Andhi are violent dust squalls that occur in the late-spring in the northwestern parts of the Indo-Gangetic Plain region of the Indian Subcontinent. They are usually brief, but they can block out the sun, drastically reduce visibility and cause property damage and injuries. They are a common precursor to the arrival of the monsoon in the northern plains. It is quite common in Punjab in the Cholistan and Thar deserts in Pakistan and Rajasthan in India.

Statement 2 is incorrect: A striking feature of the hot weather season is the 'loo'. These are strong, gusty, **hot, dry winds** blowing during the day over the **north and northwestern India.** Sometimes they even continue until late in the evening. Direct exposure to these winds may even prove to be fatal. Dust storms are very common during the month of May in northern India. These storms bring temporary relief as they lower the temperature and may bring light rain and cool breeze.

Statement 3 is incorrect: Shamal are the hot, dry and dusty wind from the north or northwest in Iraq, Iran, and the Arabian Peninsula. In June and July it blows almost continuously, but usually under 50 km (about 30 miles) per hour. The wind causes great dust storms, especially in July, when Baghdad may experience five or more such storms. The shamal is part of a widespread flow toward a low-pressure centre over Pakistan.

149. Solution: (c)

Exp) Option c is the correct answer.

The climatic conditions of India can best be described in terms of an annual cycle of seasons. The meteorologists recognise the following four seasons : (i) the cold weather season (ii) the hot weather season (iii) the southwest monsoon season (iv) the retreating monsoon season.

Statement 1 is correct: Winter monsoons do not cause rainfall as they move from land to the sea. Key factors for this are- little humidity and anti-cyclonic circulation on land. So, most parts of India do not have rainfall in the winter season. However, there are some exceptions to it such as- in **north-western India, some weak temperate cyclones from the Mediterranean Sea cause rainfall in Punjab, Haryana, Delhi and western Uttar Pradesh. Although the amount is meagre, it is highly beneficial for rabi crops.**

Statement 2 is correct: One of the main reasons for the excessive cold in north India during cold weather season is that the cold winds coming from the **Caspian Sea and Turkmenistan** during February bring cold wave along with **frost and fog over the north-western parts of India.**

150. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: In the summer season, During April and May when the sun shines vertically over the Tropic of Cancer, the large landmass in the north of Indian ocean gets intensely heated. **This causes the formation of an intense low pressure in the northwestern part of the subcontinent. Since the pressure in the Indian Ocean in the south of the landmass is high as water gets heated slowly, the low pressure cell attracts the southeast trade winds across the Equator. These conditions help in the northward shift in the position of the ITCZ.** The southwest monsoon may thus, be seen as a continuation of the southeast trade winds deflected towards the Indian subcontinent after crossing the Equator. These winds cross the Equator between 40°°E and 60°°E longitudes.

Statement 2 is incorrect: The shift in the position of the ITCZ is also related to the phenomenon of the withdrawal of the westerly jet stream (and not the easterly jet stream) from its position over the north Indian plain, south of the Himalayas. The easterly jet stream sets in along 15°°N latitude only after the western jet stream has withdrawn itself from the region. This easterly jet stream is held responsible for the burst of the monsoon in India.

Statement 3 is incorrect: The months of October and November are known for retreating monsoons. **The retreating southwest monsoon season is marked by clear skies and rise in temperature.** The land is still moist. Owing to the conditions of high temperature and humidity, the weather becomes rather oppressive. This is commonly known as the 'October heat'.

151. Solution: (d)

Exp) Option d is the correct answer.

Changes in the pressure conditions over the southern oceans affect the monsoons. Normally when the tropical eastern south Pacific Ocean experiences high pressure, the tropical eastern Indian Ocean experiences low pressure. But in certain years, there is a reversal in the pressure conditions and the eastern Pacific has lower pressure in comparison to the eastern Indian Ocean (during El Nino years). This periodic change in pressure conditions is known as the Southern Oscillation or SO.

The neutral phase of SO is when the tropical eastern south Pacific Ocean experiences high pressure, the tropical eastern Indian Ocean experiences low pressure.

The neutral phase of SO is considered good for Monsoon **(hence Assertion is wrong)** as it usually brings areas of high pressure to the western Indian Ocean **(hence Reason is correct)** but, in years when El Nino occurs, this pattern gets shifted eastward, bringing high pressure over India and suppressing the monsoon, especially in spring when the monsoon begins to develop. **Hence, option d is the correct answer.**

152. Solution: (c)

Exp) Option c is the correct answer.

During April and May when the sun shines vertically over the Tropic of Cancer, the large landmass in the north of Indian ocean gets intensely heated. This causes the formation of an intense low pressure in the northwestern part of the subcontinent.

Statement 1 is correct: Since the pressure in the Indian Ocean in the south of the landmass is high as water gets heated slowly, the low-pressure cell over the Indian landmass attracts the southeast trades across the Equator. **The southwest monsoon may thus, be seen as a continuation of the southeast trades deflected towards the Indian subcontinent after crossing the Equator.** These winds cross the Equator between 40°E and 60°E longitudes.

Statement 2 is incorrect: The Bay of Bengal branch strikes the coast of Myanmar and part of southeast Bangladesh. But the Arakan Hills along the coast of Myanmar deflect a big portion of this branch towards the Indian subcontinent. **The monsoon, therefore, enters West Bengal and Bangladesh from south and southeast instead of from the south-westerly direction.**

Statement 3 is correct: The widespread rain during the season of retreating monsoon is associated with the passage of cyclonic depressions which originate over the Andaman Sea and manage to cross the eastern coast of the southern Peninsula.

Statement 4 is correct: The Tamil Nadu **(Coromandel) coast** remains dry during southwest monsoon season. There are two factors responsible for it: (i) **The Tamil Nadu coast is situated parallel to the Bay of Bengal branch of southwest monsoon.** (ii) It lies in the rain shadow area of the Arabian Sea branch of the south-west monsoon.

153. Solution: (c)

Exp) Option c is the correct answer.

The climatic conditions of India can best be described in terms of an annual cycle of seasons. The meteorologists recognize the following four seasons: (i) the cold weather season (ii) the hot weather season (iii) the southwest monsoon season (iv) the retreating monsoon season.

The Season of Retreating Monsoon

Statements 1 and 2 are correct: The months of October and November are known for retreating monsoons. **The retreating southwest monsoon season is marked by clear skies and rise in temperature.** The land is still moist. **Owing to the conditions of high temperature and humidity, the weather becomes rather oppressive. This is commonly known as the 'October heat'.**

154. Solution: (a)

Exp) Option a is the correct answer.

During the south-west monsoon period after having rains for a few days, if rain fails to occur for one or more weeks, it is known as break in the monsoon. These dry spells are quite common during the rainy season.

Option 1 is correct. In northern India rains are likely to fail **if the rain-bearing storms are not very frequent along the monsoon trough** or the Inter Tropical Convergence Zone (ITCZ) over this region. This would result in a **drop in humidity levels in northern plains** and the surface winds start blowing from the northwest direction. This would reduce rainfall considerably.

Option 2 is correct. Over the **west coast** the dry spells are associated with days when monsoon winds blow parallel to the coast.

Option 3 is incorrect. The monsoon breaks are brought about by the **northward shifting of the monsoon trough** (minimum low-pressure cell in ITCZ). The axis of the trough lies at the foothills of the Himalayas during the break period. Consequently, **a southward position of the monsoon trough is usually an indication of well-distributed rain** over central India and the Indo-Gangetic plains.

Option 4 is incorrect. The Monsoon trough normally slopes southward with height because there is a drop in temperature. The **pressure gradient at surface levels over the Peninsular India weakens,** while it becomes **more over the Gangetic plains.** Normally, the reverse happens during the four month-long Monsoon season.

Important Tips

The Inter Tropical Convergence Zone (ITCZ) is a low-pressure zone located at the equator where trade winds converge, and so, it is a zone where air tends to ascend. In July, the ITCZ is located around 20°N-25°N latitudes (over the Gangetic plain), sometimes called the monsoon trough.

155. Solution: (b)

Exp) Option b is the correct answer.

Monsoons and the Economic Life in India:

Monsoon is that axis around which revolves the entire agricultural cycle of India. It is because about 64 per cent people of India depend on agriculture for their livelihood and agriculture itself is based on southwest monsoon. Variability of rainfall brings droughts or floods every year in some parts of the country. Regional variations in monsoon climate help in growing various types of crops.

Statement 1 is incorrect: Marathwada usually receives scanty rainfall during Monsoon. The region is far from the western coast and eastern coast – and the mountain regions of Western Ghats restricts all the weather activity and leaves very little for Marathwada and interior Peninsular India.

Statement 2 is correct: Sudden monsoon burst creates problem of soil erosion over large areas in India. Erosion due to the rainfall is a major type of water induced soil erosion.

Statement 3 is incorrect: Winter rainfall by temperate cyclones in north India is highly beneficial for rabi crops. **Monsoons do not cause rain in the north-western part of India in winters to have any beneficial effect on the rabi crops.**

156. Solution: (c)

Exp) Option c is the correct answer.

Major climatic types of India based on Koeppen's scheme Koeppen based his scheme of climatic classification on monthly values of temperature and precipitation. He used letter symbols to denote climatic types which are further sub-divided into sub-types on the basis of seasonal variations in the distributional pattern of rainfall and temperature.

He used S for semi-arid and W for arid and the following small letters to define sub-types: f (sufficient precipitation), m (rain forest despite a dry monsoon season), w (dry season in winter), h (dry and hot), c (less than four months with mean temperature over 10°C), and g (Gangetic plain). **Accordingly, India can be divided into eight climatic regions given below:**

Type of Climate	Area
1. Amw Monsoon with short dry season	West coast of India south of Goa **(Hence, pair 1 is correctly matched)**
2. As – Monsoon with dry summer	Coromandel coast of Tamil Nadu **(Hence, pair 2 is correctly matched)**
3. Aw – Tripical savannah	Most of the Peninsular plateaus, south of the Tropic of Cancer **(Hence, pair 3 is incorrectly matched)**
4. Bwhw – Semi-arid steppe climate	North-western Gujarat, some parts of western Rajasthan and
5. Bwhw – Hot desert	Punjab

6. Cwg – Monsoon with dry winter	Extreme western Rajasthan
7. Dfc – Cold humid winter with short summer	Ganga plain, eastern Rajasthan, northern Madhya Pradesh, Most of North-east India **(Hence, pair 4 is correctly matched)**
8. E – Polar type	Arunachal Pradesh (Hence, pair 5 is correctly matched) Jammu and Kashmir, Himachal Pradesh and Uttarakhand

157. Solution: (c)

Exp) Option c is the correct answer.

April, May and June are the months of summer in north India. These months of hot weather season are characterized by many local storms.

Some Famous Local Storms of Hot Weather Season:

Pair 1 is correct: Blossom Shower: Blossom Showers are the Pre-Monsoon Rains. These showers occur mainly during the March- May months, i.e., before the arrival of monsoon into India. Therefore, they are also called as the **April Rains. Blossom** Showers in Kerala, help in the **flowering** of plantation crops like Coffee and Tea. **Hence, pair 1 is correctly matched.**

Pair 2 is incorrect: Mango Shower: Towards the end of summer, there are **pre-monsoon showers** which are a common phenomenon in Kerala and coastal areas of Karnataka. Locally, they are known as mango showers since they help in the early ripening of mangoes. **Hence, pair 2 is incorrectly matched.**

Pair 3 is correct: Nor Westers: These are dreaded **evening thunderstorms in Bengal and Assam.** Their notorious nature can be understood from the local nomenclature of 'Kal-Baisakhi', a calamity of the month of Baisakh. These showers are useful for tea, jute and rice cultivation. In Assam, these storms are known as "Bardoli-Chheerha". **Hence, pair 3 is correctly matched.**

Pair 4 is correct: Loo: Loo are hot and dry winds, which blow very strongly over the northern plains of India and Pakistan in the months of May and June. Their direction is from west to east and they are usually experienced in the afternoons. Their temperature varies between 45°C to 50°C. These winds raise the temperature of the region, and exposure to these winds can even prove fatal.

Hence, pair 4 is correctly matched.

158. Solution: (d)

Exp) Option d is the correct answer.

Winter rainfall in India varies significantly across different regions due to diverse weather systems and geographical features.

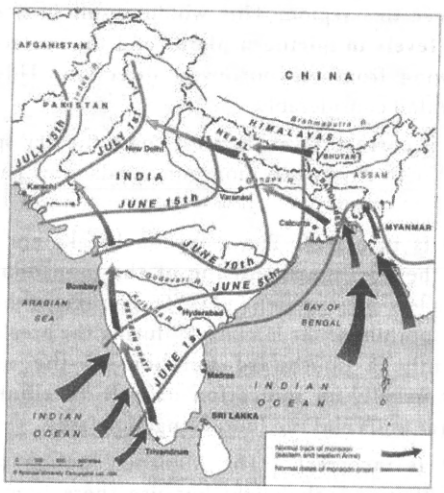
Statement 1 is correct: A characteristic feature of the cold weather season over the northern plains is the **inflow of cyclonic disturbances from the west and the northwest.** These low-pressure systems, originate over the Mediterranean Sea and western Asia and move into India, along with the westerly flow. **They cause the much-needed winter rains** over the plains and snowfall in the mountains. Although the total amount of winter rainfall locally known as 'mahawat' is small, they are of immense importance for the cultivation of 'rabi' crops.

Statement 2 is correct: Winter winds are associated with **strong anticyclonic circulation** over India. This means **air is sinking and diverging away from the region,** creating stable atmospheric conditions that **inhibit cloud formation and precipitation.**

Statement 3 is correct: During winter, the northeast monsoon winds bring significant amounts of rainfall in South India. The northeast monsoon winds initially originate from the northeast, picking up moisture as they cross the Bay of Bengal. This moisture-laden wind is then responsible for bringing torrential rainfall to South India especially Tamil Nadu, southern Andhra Pradesh, southeast Karnataka, and southeast Kerala. Over Rayalaseema (in Andhra Pradesh), the NE monsoon season contributes about 24 cm, which is 33% of this region's annual total.

159. Solution: (c)

Exp) Option c is the correct answer.



The South West Monsoon is a seasonal wind system that plays a crucial role in regulating the climate and agriculture system in India. These monsoon winds are **driven** by the difference in **pressure** between the **hot landmass of Asia and the relatively cooler Indian Ocean.**

Statement 1 is correct: The **convergence of the Arabian and Bay of Bengal branches of the monsoon occurs in the State of Punjab and Haryana.** The Arabian branch of monsoon passes over west Rajasthan, then travels to the state of Punjab and Haryana. Here, it joins the Bay of Bengal branch. These two branches, reinforced by each other, cause rains in the western Himalayas.

Statement 2 is correct: The monsoon winds approach the State of **West Bengal from the south and south-east**

direction. This is because the **Bay of Bengal branch of the monsoon winds gets deflected by the Arakan mountain range** located in Myanmar.

160. Solution: (c)

Exp) Option c is the correct answer.

Temperatures in northern India can soar to 40-45°C or even higher during peak summer months i.e. May. Whereas temperatures in Peninsular India reach 35-40°C on average. However, unlike northern India, peninsular India does not have a well defined climatic season due to the moderating effect of sea on land.

Statement-I is correct: Peninsular India indeed does not have a well-defined cold weather season compared to Northern India. This is primarily due to the moderating influence of the surrounding seas on land. During the summer months, the sea absorbs the excess heat from the landmass, preventing temperatures from rising too high. **Conversely, during winter, the sea releases its stored heat back to the atmosphere, moderating the temperature drop and preventing the region from experiencing extreme cold.**

Statement-II is incorrect: Peninsular India is surrounded by the **Arabian Sea on the west and the Bay of Bengal on the east.** The presence of these **warm seas moderates the temperature in Peninsular India,** preventing it from dropping significantly during winter months and rising abruptly during summer months. The location of peninsular India closer to the Sea is the reason why it lacks a well-defined climate season.

161. Solution: (a)

Exp) Option a is the correct answer.

Monsoon rainfall in India depends on various factors such as El Nino, Easterly jet stream and Madden-Julian Oscillation (MJO). These phenomena often interact with each other and can have a combined effect on the Indian monsoon.

Statement 1 is incorrect: El Niño **typically leads to reduced monsoon rainfall in India, causing droughts.** El Niño is a global climate phenomenon that occurs every 2-7 years, characterised by **warming sea surface temperatures in the Eastern Pacific Ocean**. It weakens the Southwest monsoon thus delaying the onset of monsoon rainfall and leading to below average monsoon rainfall in India.

Statement 2 is correct: The easterly jet stream is a band of fast-moving air, high in the troposphere. It **steers the tropical depressions into India. These depressions play a significant role in the distribution of monsoon rainfall** over the Indian subcontinent. The tracks of these depressions are the **areas of highest rainfall** in India.

On the other hand, **southward shift of easterly jet stream** during winter weakens the monsoon circulation, leading to dry conditions in India.

Statement 3 is incorrect: The Madden-Julian Oscillation (MJO) is a large-scale eastward-moving band of clouds and precipitation that circles the globe in the tropics roughly every 30-60 days. The presence of convective phase of **MJO over the Indian Ocean typically enhances monsoon rainfall (not reduces).** The **enhanced rainfall (or convective) phase involves** convergence of winds at the surface forcing air to diverge at the atmosphere. Such motion tends to increase condensation and rainfall.

On the other hand, **suppressed rainfall phase of MJO** involves winds converging at the top of the atmosphere, **forcing air to sink and diverge at the surface.** As air sinks from high altitudes, it warms and dries, which suppresses rainfall.

162. Solution: (a)

Exp) Option a is the correct answer.

India's climate is **primarily monsoon,** but it has a **mixed climate** due to its location in the tropical and subtropical regions. India's climate is influenced by its **location in the Asian continent and the Indian Ocean.** The **Himalayan mountains** also play a role in India's climate by **trapping the monsoon and preventing cold air from Asia from reaching the Northern Indian plains**. Apart from that, **altitude, distance from the sea, latitude, and distribution of land and water** also plays an important role in affecting the India's climate.

Statement 1 is incorrect- While **latitude plays** a significant role in determining climate, other factors like **altitude, ocean currents, and proximity to land masses** also have a significant influence. As an illustration, **Agra and Darjeeling share the same latitude**, yet the temperature in **Agra during January is 16°C, while in Darjeeling, it is only 4°C. So, they do not have similar climate factors, despite of being on the same latitude.**

Statement 2 is correct- The Peninsular region of India, does not have any well-defined cold weather season as there is hardly any seasonal change in the distribution pattern of the temperature in coastal areas because of moderating influence of the sea and the proximity to equator. For example, the mean maximum temperature for January at Thiruvanantapuram is as high as 21°°C, and for June, it is 29.5°°C.

Statement 3 is incorrect- While **mountains can influence rainfall** by acting as **barriers and forcing moist air to rise and condense,** other factors like **wind direction and seasonal weather systems** also play crucial roles. For example, if the **wind direction is parallel to the mountain ranges**, there **would be no rainfall** in that region as mountain ranges is **not obstructing the wind flow**. For example, the **absence** of **rainfall** in **Western Rajasthan** from the **Arabian Sea branch** of the South-West Monsoon winds is attributed to the **parallel direction of the winds to the Aravali hills.** As the moisture-laden winds **do not directly encounter the mountains**, they **fail to induce rainfall in Western Rajasthan.**

163. Solution: (b)

Exp) Option b is the correct answer.

The **Northeast monsoon** typically spans from **October to December in India**, with winds blowing from the **northeast to the southwest**, resulting in relatively **dry weather in the Indian subcontinent**. The **Intertropical Convergence Zone (ITCZ)**, a **low-pressure belt** encircling the Earth

near the equator, is characterized by **rising air, leading to cloud formation and precipitation**. During the Northeast monsoon, the **ITCZ shifts southward**, serving as the **primary catalyst for wind reversal.** This shift in pressure patterns induces a **draw of winds** from the **Southern Hemisphere**, carrying **moisture** and causing the **reversal** from the **usual northeast monsoon winds to south and southwest directions.**

164. Solution: (b)

Exp) Option b is the correct answer.

Cyclones are caused by atmospheric disturbances around a low-pressure area distinguished by swift and often destructive air circulation. The air circulates inward in an anticlockwise direction in the Northern hemisphere and clockwise in the Southern hemisphere. In Indian Subcontinent, on an average, five to six tropical cyclones form every year. More cyclones occur in the Bay of Bengal than the Arabian Sea and the ratio is approximately 4:1.

Statement I is correct: The Bay of Bengal is relatively shallow than the Arabian sea. **Its larger shallow surface area allows faster heating raising sea surface temperature which is favorable to cyclone formations.** Whereas Arabian Sea is deeper than Bay of Bengal.

Statement II is also correct but not the right explanation of Statement I: Due to Climate change cyclone formation is amplifying in the Arabian Sea. Mainly through elevated sea surface temperatures (SST) which serve as a catalyst for cyclone genesis and intensification. As per Elsevier's Earth Science Review, the SST over Arabian Sea increased by 1.2° C to 1.4°c in recent decades compared to four decades ago. It provides a fertile environment for cyclones to develop and strengthen.

165. Solution: (a)

Exp) Option a is the correct answer.

The Indian monsoon is a seasonal weather pattern characterized by the systems driven by the differential heating of land and sea, which creates low-pressure over the Indian landmass, drawing moisture-laden winds from the Indian Ocean.

Various factors influencing the Indian monsoon include ocean temperature anomalies, atmospheric circulation patterns, land-ocean temperature gradients, EL NINO southern oscillation, LA NINA, and tropical weather phenomena like the tropical cyclones, Madden-Julian Oscillation and the Indian Ocean Dipole.

Statement 1 is correct: The easterly jet stream is a narrow band of strong winds in the upper atmosphere that flows from east to west, i.e from east coast of Vietnam to the west coast of Africa.

When the Easterly jet stream reaches the area near Madagascar, it descends towards the ocean surface. This descent leads to the formation and intensification of a high-pressure area over the southwestern Indian Ocean. This creates a large pressure gradient between the high-pressure area over the southwestern Indian Ocean and the low-pressure area over the Indian subcontinent. It therefore drives the southwest monsoon towards Indian subcontinent.

Statement 2 is correct: The summer heating of Tibetan Plateau makes it a high-level heat source (hence acting as a heat engine), it produces a thermal anticyclone over the region. This anticyclone weakens the western sub-tropical jet stream south of Himalayas and produces tropical easterly jet on the anticyclone's southern side. This tropical easterly jet extends westwards till Eastern African coast and hence augments the high pressure in the southwestern Indian Ocean, hence strengthening the Indian monsoon.

Statement 3 is incorrect: Cyclones formed in Arabian sea and Bay of Bengal can both enhance the progression of the Monsoon or can suppress it, depending on various factors.

Cyclones in the Arabian Sea:

1) Can **enhance** rainfall by:
   a. Acting as moisture pumps, drawing vast amounts of water vapor from the sea and potentially transporting it towards India through prevailing winds.
   b. Occasionally **strengthening monsoon winds** in certain regions due to their circulation patterns.
2) Can **temporarily disrupt** the monsoon by:
   a. Diverting moisture away from its usual path.
   b. Causing "breaks" in the monsoon with reduced rainfall in specific areas.

Cyclones in the Bay of Bengal:

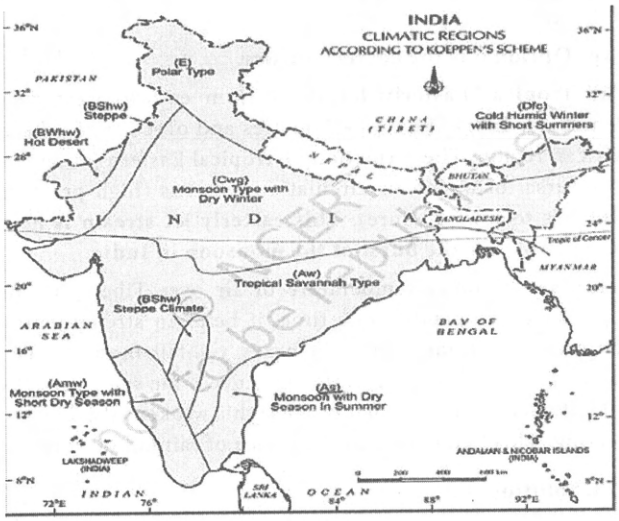
1) Can also **enhance** rainfall over India due to similar mechanisms mentioned above for the Arabian Sea.
2) Can **disrupt the monsoon flow** in some cases, potentially leading to **localized reductions** in rainfall.

Therefore, it's **inaccurate** to say that cyclones in the **Arabian Sea** always enhance the monsoon while those in the **Bay of Bengal** always suppress it. Their impact depends heavily on factors like the cyclone's **strength, location, and interaction with other weather systems.**

166. Solution: (b)

Exp) Option b is the correct answer.

Köppen›s climate classification is based on the concept of defining climate zones according to the predominant vegetation types associated with particular temperature and precipitation patterns.



As per Koeppen's classification semi-arid steppe climate is represented by BShw. It has an average annual rainfall of 12 to 25 cm, and most of it occurs in summer and winter is dry. **It is found in some rain shadow areas of Western Ghats particularly in states of Maharashtra and Karnataka, large part of Rajasthan and contiguous areas of Haryana and Gujarat.**

167. Solution: (b)

Exp) Option b is the correct answer.

Monsoon rainfall variability refers to the degree to which rainfall amounts fluctuate over time, both spatially and temporally. It encompasses variations in the timing, intensity, frequency, and distribution of rainfall events within a particular region or over a specific period.

Statement I is correct: There are large variations in the total amount of rainfall from year to year.

Statement II is correct: Rainfall variability is highest where the amount of rainfall is lowest. In other words, rainfall variability is inverse to total amount of rainfall.

For example, Rajasthan is known for experiencing very high monsoon rainfall variability in India.

But Statement II does not explain Statement I: Onset, Advancement and Withdrawal of monsoon decide the duration and period of monsoon currents at different places. This leads to variations in the total amount of rainfall. These processes subjected to various ocean-atmospheric interactions like El Nino Southern oscillation (ENSO), Indian Ocean Dipole (IOD) North Atlantic Oscillation (NAO) and Pacific Decadal Oscillations (PDO).

168. Solution: (a)

Exp) Option a is the correct answer.

Statement-I is correct: Mawsynram and Cherrapunji, located in the Khasi Hills of Meghalaya, are known as the **two wettest spots on Earth.** They receive **more than 1,080 cm of rainfall annually.** For instance, recently the rainfall received in these areas is about 30 times greater than the rainfall the entire country gets in June during the Southwest monsoon.

Statement-II is correct and explains the Statement-I: Cherrapunji and Mawsynram, the world's wettest places, annually receive over 1000 cm of rainfall due to their strategic positioning on the high-altitude southern slope of the Khasi Hills. Khasi hill regions serve as a natural barrier to the Southwest monsoon winds from the Bay of Bengal. As these moisture-laden winds encounter the elevated terrain, they are compelled to ascend, undergoing cooling and condensation, leading to the formation of clouds. This process, known as orographic lifting leading to the heavy precipitation witnessed in these areas.

Furthermore, the presence of a funnel-shaped catchment area intensifies the convergence of moisture, augmenting the already substantial rainfall. The combined effect of orography and the unique catchment shape creates an environment conducive to extreme rainfall, making Cherrapunji and Mawsynram making them wettest places on the earth. Hence statement II is correct and explains the statement-I.

169. Solution: (b)

Exp) Option b is the correct answer.

Various regions of India encounter unique local storms during the hot weather season. These local storms are associated with violent winds, torrential rains and even hailstorms. Additionally, they play a role in ripening fruits and triggering the flowering of different plants. Examples of these phenomena include Norwesters ,Blossom Showers in Kerala and Loo in the Northern plains.

Statement 1 is correct: Norwesters are dreaded evening thunderstorms in Bengal and Assam. In Assam, these storms are known as "Bordoisila" or "Bardoli Chheerha". Their notorious nature can be understood from the local nomenclature of 'Kalbaisakhi' (in West Bengal) a calamity of the month of Baisakh.

Statement 2 is incorrect: Norwesters occur typically before monsoon season and most prevalent in the months of **April and May.**

Statement 3 is correct: Norwesters brings destruction in terms of lightning, thunderstorm, hailstorm and rainfall. However, it is **extremely helpful for the pre-Kharif crops like tea, jute and rice cultivation in the Bengal and Assam region.** It gives the much-desired relief after midday heat and pours well on the thirsty soil for development of crops.

170. Solution: (a)

Exp) Option a is the correct answer.

Western cyclonic disturbances are low-pressure systems that originate over the Mediterranean Sea and travel over Iran, Iraq, Afghanistan, and Pakistan before entering India. These wind systems are influenced by subtropical westerly jet streams and cause rainfall.

Statement 1 is incorrect: Western cyclonic disturbances, which affect the Indian subcontinent during the winter months, **do not originate over the Arabian Sea but over**

the Mediterranean Sea in the European region. These disturbances move eastward across West Asia, Iran, Afghanistan, and Pakistan before reaching northwestern parts of India.

Statement 2 is incorrect: The western cyclonic disturbances are primarily **brought into India by the westerly jet streams, not by the trade winds.** Trade winds are air currents closer to Earth's surface that blow from east to west near the equator. On the other hand, **Jet streams** are currents of air high above Earth's surface and move **at altitudes of about eight to 15 kilometers (five to nine miles).**

Statement 3 is correct: During winters in India, the weather is generally pleasant. However, this pleasant weather is occasionally disrupted by shallow **western cyclonic depressions.** Along their journey, they gather **moisture from the Caspian Sea** in the north and the **Persian Gulf** in the south. In **northwestern India, these cyclonic disturbances can cause rainfall in regions such as Punjab, Haryana, Delhi, and western Uttar Pradesh.** Although the amount of rainfall is usually small, it is highly beneficial for rabi crops such as wheat in the region.

171. Solution: (b)

Exp) Option b is the correct answer.

The months of October and November are known for retreating monsoons because during this time, the south-west monsoon winds weaken and start withdrawing gradually. The retreating southwest monsoon season is marked by clear skies and rise in temperature in Northern India.

Statement 1 is correct: The **apparent movement of the Sun towards the Tropic of Capricorn plays a crucial role in weakening and withdrawing the Southwest monsoon winds from the Indian subcontinent.** As the Sun moves, the low-pressure trough over the Ganga plain also shifts southward. By mid-December, this low-pressure center completely retreats from the Peninsula.

Statement 2 is incorrect: This season witnesses extreme cyclonic activity wreaking havoc in the regions of Southeastern peninsular India such as Odisha, Andhra Pradesh and Tamil Nadu. The low-pressure depressions originate over the Andaman Sea which often cross the eastern coast of the southern Peninsula, causing significant destruction. Particularly vulnerable are densely populated deltas such as those of the Godavari, Krishna, and Kaveri rivers. Cyclonic storms also affect the coasts of West Bengal, Bangladesh, and Myanmar.

Statement 3 is correct: While North India experiences dry weather during the retreating monsoon, the **eastern part of the Peninsula receives rainfall.** October and November are the rainiest months in this region, largely due to the influence of these cyclonic systems. Thus, it is true that **Coastal areas of Tamil Nadu derive most of the rainfall during this season.** This rainy extension of the generally dry retreating monsoon in Tamil Nadu is called the northeast, or winter, monsoon.

172. Solution: (b)

Exp) Option b is the correct answer.

The **Tropical Easterly Jet** flows from east to west over Peninsular India at 6 to 9 kilometres and over the Northern African region. The formation of Tropical Eastern Jet results in reversal of upper air circulation patterns (high pressure switches to low pressure). **This easterly jet stream is held responsible for the burst of the monsoon in India.**

When the summer temperature of air over Tibet remains high for a sufficiently long time, it helps in strengthening the easterly jet and results in heavy rainfall in India. The easterly jet does not come into existence if the snow over the Tibet Plateau does not melt because this weakens the Tibetan heating. This hampers the occurrence of rainfall in India.

173. Solution: (c)

Exp) Option c is the correct answer.

During the summer months in India, a sudden contact between dry and moist air masses gives rise to local storms of great intensity. These local storms are associated with violent winds, torrential rains and even hailstorms.

Some Famous Local Storms of Hot Weather Season

(i) Mango Shower : Towards the end of summer, there are pre-monsoon showers which are a common phenomena in Kerala and coastal areas of Karnataka. Locally, they are known as mango showers since they help in the early ripening of mangoes.

(ii) Blossom Shower : With this shower, coffee flowers blossom in Kerala and nearby areas.

(iii) Nor Westers : These are dreaded evening thunderstorms in Bengal and Assam. Their notorious nature can be understood from the local nomenclature of 'Kalbaisakhi', a calamity of the month of Baisakh. These showers are useful for tea, jute and rice cultivation. In Assam, these storms are known as "Bardoli Chheerha". (Hence Option c is correct)

(iv) Loo : Hot, dry and oppressing winds blowing in the Northern plains from Punjab to Bihar with higher intensity between Delhi and Patna.

174. Solution: (a)

Exp) Option a is the correct answer.

Statements I and II are correct: The Arakan Hills along Myanmar's coast **deflect a large chunk of the Bay of Bengal branch towards the Indian subcontinent.** As a result, the monsoon approaches **West Bengal and Bangladesh from the south and southeast rather than the south-westerly path. Thus, Statement II is the correct reason of Statement I.**

175. Solution: (c)

Exp) Option c is the correct answer.

The Indian monsoon is a seasonal wind system that brings heavy rainfall to the Indian subcontinent, primarily from June to September. It is driven by the differential heating of land and sea, leading to the formation of low-pressure zones

over the Indian landmass. It brings 80% of India's annual rainfall.

Statement 1 is correct: The **Indian monsoon** is primarily influenced by the **seasonal reversal of wind direction.** During winter, a high-pressure system forms north of the Himalayas, causing cold, dry winds to blow southward toward the low-pressure areas over the oceans. **In summer, a low-pressure zone develops over interior Asia and northwestern India, leading to a complete reversal of wind direction.** Moisture-laden winds from the southern Indian Ocean move northward, cross the equator, and turn right due to the Coriolis effect, resulting in the Southwest Monsoon winds. The **Indian monsoon** is primarily influenced by the **seasonal reversal of wind direction.**

Statement 2 is correct: In the Ganga valley, monsoon rainfall decreases from east to west. This is because the monsoon winds first reach eastern India (West Bengal, Bihar, Jharkhand, etc.), where they cause heavy rainfall. As these winds move westward, they lose moisture, leading to a gradual decline in rainfall from Uttar Pradesh to Rajasthan.

176. Solution: (d)

Exp) Option d is the correct answer.

Köppen's climatic classification categorizes India's climate based on temperature, precipitation, and seasonal variations. The major types include Tropical Monsoon (Am), Tropical Savannah (Aw), Semi-Arid Steppe (BShw), Hot Desert (BWhw), and Monsoon with Dry Winters (Cwg). The BShw climate features low annual rainfall (12–25 cm), mostly in summer, with dry winters and arid steppe vegetation adapted to harsh conditions.

Option 1 is correct: Some areas on the leeward side of the Western Ghats exhibit a BShw climate, characterized by semi-arid conditions. This occurs due to the orographic effect, where the mountains obstruct moisture-laden winds, resulting in reduced rainfall.

Option 2 is incorrect: The Coromandel Coast receives significant rainfall during the Northeast Monsoon (October-December) and **does not have a semi-arid steppe climate.** It falls under the Tropical Wet and Dry Climate (Aw) or Tropical Monsoon Climate (Am) in Köppen's classification.

Option 3 is incorrect: The Malwa Plateau experiences a monsoon type with dry winters (Cwg) rather than a semi-arid steppe climate. It gets moderate rainfall from the Southwest Monsoon, making it unsuitable for classification as semi-arid.

Option 4 is correct: Parts of southern Haryana and Punjab experience semi-arid conditions with low rainfall. These areas exhibit characteristics of the BShw climate, with sparse vegetation and dry conditions.

177. Solution: (d)

Exp) Option d is the correct answer.

The Southwest Monsoon in India, originating over the Indian Ocean, is divided into two branches: the Arabian Sea branch and the Bay of Bengal branch. The Arabian Sea branch brings heavy rainfall to the western coast, affecting states like Kerala, Karnataka, and Maharashtra. The Bay of Bengal branch primarily brings rainfall to the northeastern states of India.

Statement I is correct: Both branches of the Southwest Monsoon bring rainfall to various parts of India, but the **Tamil Nadu coast remains dry during the Southwest Monsoon season.**

Statements II and III are incorrect: Tamil Nadu lies in the rain shadow region of the Arabian Sea branch of the South West Monsoon, which prevents significant rainfall from reaching the region. **However, the Tamil Nadu coast is situated parallel to the Bay of Bengal branch of the southwest monsoon.**

Thus Tamil Nadu remains dry during the monsoon season because it lies parallel to the Bay of Bengal branch and lies in the rain shadow region of the Arabian Sea branch of the South West Monsoon.

178. Solution: (a)

Exp) Option a is the correct answer.

Local winds blow over short distances and have a significant impact on local weather patterns and agriculture. Examples of local winds in India include Mango Shower, Blossom Shower, Nor Westers and Loo.

Row 1 is correct: Blossom Showers occur **in Kerala** during the pre-monsoon period. They are beneficial for **coffee cultivation.**

Row 2 is incorrect: Nor westers are intense evening thunderstorms in **Bengal and Assam**, often accompanied by heavy rain and strong winds. These storms, also called "Bardoisila" in Assam, are beneficial for the **cultivation of tea, jute, and rice**, as they provide much-needed rainfall during the pre-monsoon period.

Row 3 is incorrect: The **Loo** is a hot, dry, and oppressive wind that sweeps across the northern plains, from **Punjab** to Bihar, peaking in intensity between Delhi and Patna, including **Haryana**, during **May and June**. However, it does **not** facilitate wheat harvesting, as **wheat**, a **rabi crop**, is sown between **late October and December**, ripens by **mid-March**, and is typically harvested by late March for early sown varieties.

179. Solution: (a)

Exp) Option a is the correct answer.

The period from October to December is considered one of the most favorable times for the development of cyclones in the Bay of Bengal and the Arabian Sea. Several meteorological and oceanic factors contribute to this increased cyclone activity during these months.

Option 1 is correct: The **retreating monsoon (October to December) creates favorable atmospheric** conditions for cyclone formation. During this period, weak wind shear allows cyclones to develop and intensify without disruption.

Option 2 is correct: The **sea surface temperatures (SST) in the Bay of Bengal and the Arabian Sea remain high and**

conducive (above 26.5°C) during this period, providing the necessary heat and moisture for cyclone formation.

Option 3 is incorrect: High humidity (around 50 to 60 per cent) in mid-troposphere is required for cyclone formation because it leads to formation of cumulonimbus clouds. And also subsequently provides the latent heat needed to intensify cyclonic systems. Low humidity would inhibit cyclone development.

Option 4 is incorrect: The ITCZ **shifts southward during the October to December period** as the Sun moves south of the equator (toward the Tropic of Capricorn) during this time. As the ITCZ shifts southward, it creates favorable conditions for the formation of low-pressure systems in the Bay of Bengal and the Arabian Sea.

180. Solution: (a)

Exp) Option a is the correct answer.

The cold weather season i.e. winter season in India begins from mid-November and stays till February.

Statement 1 is correct.

During the Winter season, the northeast trade winds prevail over the country. The northeast trade winds blow from land to sea in most of North India during the winter season. They blow from land to sea and hence, for most part of the country, it is a dry season.

However, in some parts in India it blows from sea to land. Some amount of rainfall occurs on the Tamil Nadu coast from these winds as, here they blow from sea to land.

Statement 2 is incorrect. The influence of easterly trade winds **creates a counter-equatorial current** which flows between the north equatorial current and the south equatorial current in west-east direction. This raises the level of western Indian (south-east of horn of Africa) ocean by few centimetres.

There is **no counter-equatorial current in summer.** Due to the effects of the strong south-west monsoon and the absence of the north-east trades in summer, a strong current flow from west to east, which also completely obliterates the north equatorial current. Hence, the absence of counter-equatorial current.

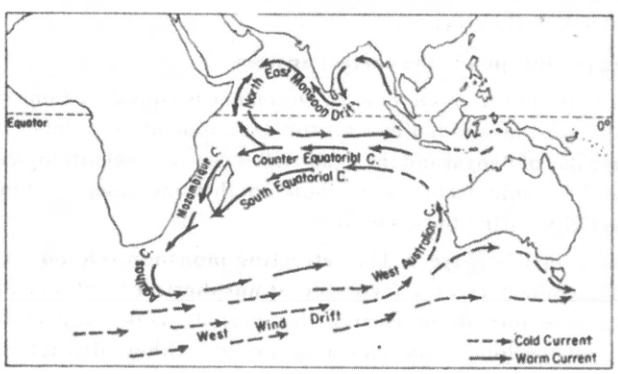


Fig 8.12 The Currents of the Indian Ocean (Winter)

181. Solution: (c)

Exp) Option c is the correct answer.

The El Nino Southern Oscillation (ENSO) phenomenon involves fluctuating ocean temperatures in the central and eastern equatorial Pacific, coupled with changes in the atmosphere.

Option a is incorrect. The recent IMD forecast warns of an impending **La Nina effect, (not El Nino), that will lead to a major dip in temperature across north India.** For the northern parts of India, it is likely that the La Nina weather phenomenon may result in extreme cold from December 2021 to February 2022. While La Niña is referred to as the cold phase of ENSO, El Niño is the warm phase of ENSO. Both La Niña and El Niño are deviations from the normal surface temperatures of the Pacific Ocean.

Option b is incorrect. The tropical cyclones develop in the Bay of Bengal due to **vast low pressure created by the higher sea surface temperature.** They also develop under the influence of western disturbances. The frequency and direction of these cyclones influence weather conditions along the eastern coast during October, November and December.

Research finds that changes in the Bay's cyclone environment were caused by decades-long changes in the El Niño Southern Oscillation, or ENSO, a regular pattern variation of winds and sea surface temperatures affecting the tropics and sub-tropics. The ENSO triggers an atmospheric wave that helps instigate the May-June monsoon circulation over the Bay of Bengal, which then becomes responsible for initiating a north-south dipole of tropical cyclone activity.

Option c is correct. The southern oscillation is a pattern of meteorological changes which are often observed between Indian and Pacific oceans. Normally when the tropical eastern South Pacific Ocean experiences high pressure, the tropical eastern Indian Ocean experiences low pressure. But in certain years, there is a reversal in the pressure conditions and the **eastern Pacific has lower pressure in comparison to the eastern Indian Ocean.** This periodic change in pressure conditions is known as the Southern Oscillation or SO. It has been noticed that when the pressure is high over the Pacific Ocean and low over Indian Ocean, the Southwest monsoons in India tend to be weaker. In the reverse case, the monsoons are most likely to be stronger.

Option d is incorrect. As per the traditional theory, seasonal reversal of winds is **caused by the differential heating of land and sea** (and not El Nino Southern Oscillation (ENSO)). Due to a higher temperature over the land in summer, a low-pressure area develops over the continents and the winds blow from neighbouring oceans towards the land. These winds are of maritime origin and hence cause ample rainfall in summer.

However, German meteorologist Flohn argues that the origin of the monsoon is **caused by the seasonal shift of the pressure and wind belts** under the **influence of the shift of the vertical rays of the sun.**

Important Tips

Western Disturbances are low pressure systems, embedded in western winds (westerlies) that flow from west to the east. It originates in the Mid- latitude region over the Mediterranean Sea and travels over Iran, Iraq, Afghanistan and Pakistan before entering India loaded with moisture.

182. Solution: (c)

Exp) Option c is the correct answer.

The Jet Stream is a geostrophic wind blowing horizontally through the upper layers of the troposphere, generally from west to east, at an altitude of 20,000 - 50,000 feet.

Statement 1 is correct. The **subtropical westerly jet streams** blowing over India in **winter cause a high pressure over northern India**. It thus **intensifies the northeast monsoons.** This jet stream shifts northwards beyond India in summer season and tropical easterly jets develop over India in this season.

Statement 2 is correct. The behaviour of jet streams (subtropical westerly and tropical easterly jet streams) is partly responsible for the **variations in the time of onset of southwest monsoons** over India and the strength of the monsoon. Timing of the shift of the subtropical westerly jet at the beginning of summer is critical to the onset of the southwest monsoon over India. If the shift is delayed, so is the southwest monsoon. The strength of the easterly tropical jet over central India determines the strength of the southwest monsoon.

A **strong easterly tropical jet results in a strong southwest monsoon** and a weak jet result in a weak monsoon.

183. Solution: (c)

Exp) Option c is the correct answer.

The Peninsular region of India does not have any well-defined cold weather season. Also, there is hardly any seasonal change in the distribution pattern of the temperature in coastal areas.

The Peninsular region of India does not have any well-defined cold weather season because of **moderating influence of the sea and the proximity to equator.** For example, the mean maximum temperature for January at Thiruvananthapuram is as high as 31°C, and for June, it is 29.5°C. **The air pressure is lower in these regions. Due to a low-pressure gradient, the light winds blow outwards of the region.**

184. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct.

The word monsoon is derived from the Arabic word 'Mausim' which means season. Monsoon refers to the seasonal reversal in the wind direction during a year. The Southern part of India, being near to the sea, gets rainfall early and for a **longer duration than in the northern part**. As rain-bearing winds cross western ghats humidity decreases and so does rainfall in the northern part of India. The Southern part of India receives rainfall from the southwest monsoon and the retreating southwest monsoon (northeast monsoon).

Statement 2 is correct.

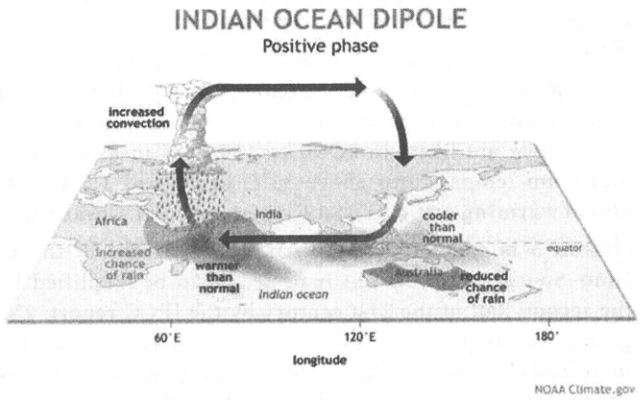
The Bay of Bengal is the main branch of the monsoon winds which moves from northeast and then hits Himalayas to return westwards by covering the northern plains. As the winds move westward, their moisture contains tends to reduce as they cause rains along Indian subcontinent. So that the rainfall decreases from east to west in northern India. The Arabian Sea branch does not contribute much and exhaust most of its moisture when it hit Western Ghats.

185. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect.

The Indian Ocean Dipole (IOD) is defined by the difference in sea surface temperature between two areas (or poles, hence a dipole) – a wes**tern pole in the Arabian Sea (western Indian Ocean) and an eastern pole in the eastern Indian Ocean south of Indonesia.** The IOD affects the climate of Australia and other countries that surround the Indian Ocean Basin, and is a significant contributor to rainfall variability in this region.



Statement 2 is correct.

Indian Ocean Dipole is a coupled ocean and atmosphere phenomenon, similar to ENSO but in the equatorial Indian Ocean. It is thought that the **IOD has a link with ENSO** events through an extension of the Walker Circulation to the west and associated Indonesian throughflow (the flow of warm tropical ocean water from the Pacific into the Indian Ocean). Hence, **positive IOD events are often associated with El Niño and negative events with La Niña.** When the **IOD and ENSO are in phase the impacts of El Niño and La Niña events are often most extreme over Australia**, while when they are out of phase the impacts of El Niño and La Niña events can be diminished.

Positive event of Indian Ocean Dipole:

- warmer sea surface temperatures in the western Indian Ocean relative to the east
- easterly wind anomalies across the Indian Ocean and less cloudiness to Australia's northwest

- less rainfall over southern Australia and the Top End.

Negative event of Indian Ocean Dipole:

- cooler sea surface temperatures in the western Indian Ocean relative to the east
- winds become more westerly, bringing increased cloudiness to Australia's northwest
- more rainfall in the Top End and southern Australia.

186. Solution: (c)

Exp) Option c is the correct answer.

According to **the Intergovernmental Panel on Climate Change (IPCC) report** titled 'Climate Change 2021: The Physical Science Basis', glacial retreat in the Hindu Kush Himalayas; compounding effects of sea-level rise and intense tropical cyclones leading to flooding; an erratic monsoon; and intense heat stress are likely to impact India in recent years.

Option 1 is correct. The Indian Ocean, which includes the Arabian Sea and Bay of Bengal, has warmed faster than the global average. The oceans factsheet released by IPCC indicates that **sea surface temperature over Indian ocean is likely to increase by 1 to 2 degrees C (°C)** when there is 1.5°C to 2°C global warming. The rapid warming of Indian Ocean would lead to **powerful and intense cyclones in the region.**

Option 2 is incorrect. As per the IPCC report, heat extremes have increased while cold extremes have decreased, and these trends will continue over the coming decades over Asia. There are likely to be **90 to 120 days** in a year with maximum temperatures above **35°C in case of 1.5 to 2°C global warming** and over **180 days in case of 4°C warming.**

Option 3 is correct. Rainfall variability related to the El Niño–Southern Oscillation is projected to be amplified by the second half of the 21st century by the IPCC report. 2°C global warming has serious implications due to possible increases in extreme weather events like heat waves, **heavy precipitation, intensification of tropical cyclones etc.** Many regions are projected to experience an increase in the probability of compound events (i.e., different types of extreme events happening at the same time or one after the other). For example, **drought followed by heat waves.** Dry becomes drier and wet becomes wetter. This can be particularly alarming for India.

5.4. Natural Vegetation

187. Solution: (a)

Exp) Option a is the correct answer.

Tropical deciduous forests, also known as **monsoon forests**, are found in regions with **heavy rainfall and a dry season.** They are **dense and lush during the wet season but** become **dry and leafless during the dry season.**

Statement 1 is incorrect - The **tropical dry deciduous forest** thrives throughout the **northern parts of the country, excluding the northeast**, and extends its presence into **Madhya Pradesh, Gujarat, Andhra Pradesh, Karnataka, and Tamil Nadu.** The distribution is notably correlated with regions experiencing a moderate to substantial annual rainfall ranging between **70 to 100 cm**. On the other hand, **Thorn forests occur in the areas that receive annual rainfall less than 50cm.**

Statement 2 is correct- At the onset of the dry season, the trees in the tropical dry deciduous forest undergo complete leaf shedding, transforming the forest into a vast grassland with bare trees dotting the landscape.

Statement 3 is incorrect- Mahogany and Ebony species are found in **tropical evergreen forests.** On the other hand, **Tendu, palas, amaltas, bel, khair, axlewood, etc** are prevalent in the **tropical dry deciduous forests.**

188. Solution: (c)

Exp) Option c is the correct answer.

The tropical wet evergreen forest in India is usually found in areas receiving more than 200 cm of rainfall and having a temperature of 15-30 degrees Celsius. Tropical evergreen forests are found in warm and humid areas. Tropical evergreen forests are well stratified, with layers closer to the ground and are covered with shrubs and creepers, with short structured trees followed by tall variety of trees.

Option c is correct. These forests are found in the plains, on low hills and gentle slopes of the foothills of the mountains, at elevations ranging from almost sea level up to about 1000–1200 m. They occur in the states of **Maharashtra, Karnataka, Tamil Nadu, Kerala, Andaman and Nicobar Islands and in the entire north-eastern region (including Arunachal Pradesh and Mizoram)** including the sub-mountain division of West Bengal.

The forests of Himachal Pradesh include Coniferous Forests and broad-leaved Forests. The vegetation varies from Dry Scrub Forests at lower altitudes to Alpine Pastures at higher altitudes. The tropical wet evergreen forest is not found in Himachal Pradesh.

189. Solution: (d)

Exp) Option d is the correct answer.

Khejri is an important tree of dry lands. Khejri tree plays a vital role in maintaining the ecosystem of the **dreary Thar region** because of its ability to survive in such tough conditions. **Apart from being a source of firewood and fodder,** the Khejri also helps in sustaining the nutrient value of the soil and ensuring a good yield.

Statement 1 is correct. Khejri (Prosopis cineraria) covers about **two-thirds of the total geographical area of the State and is of immense significance culturally and economically.**

Statement 2 is correct. The fruit is used to make the very popular local dish 'Sangri' and can fetch up to Rs 300 per kilo for the farmers. "Khejri bark is used medicinally for a range of ailments and can be ground up and made into flour, and famously, saved thousands of lives during the Great Rajputana Famine of 1868. The flowers make an amazing bee-fodder.

Statement 3 is correct. In 1730 AD, around 363 people sacrificed their lives in an attempt to save the trees by hugging them while the then king's men chopped their bodies with axes. **The trees which they were protecting were 'Khejri'. In 1970s, this sacrifice became the inspiration behind the Chipko Movement.**

Statement 4 is correct. It is the state tree of Rajasthan. However, the tree is said to be dying vis-a-vis losing its natural cover. The root cause of decline in the Khejri cover is its excessive lopping (cutting of branches), which all farm owners do annually to procure its fruit, pods, leaves, branches and twigs.

190. Solution: (c)

Exp) Option c is the correct answer.

Alluvial soil can be classified into two groups on the basis of its age - the khaddar and the bhangar. The former is light in colour and is made up of newer deposits. The latter is the older alluvium and is composed of lime nodules or kanker and its composition is clayey.

Statement a is incorrect. The Bhabar is a narrow belt about 8-16 km wide running in east-west direction along the foot of the Shiwalik. Rivers descending from the Himalayas deposit their load along the foothills in the form of alluvial fans.

Therefore, **the area is marked by dry river courses except in the rainy season**. The Bhabar belt is comparatively narrow in the east and extensive in the western and north-western hilly region. **The area is not suitable for agriculture and only big trees with large roots thrive in this belt.**

Statement b is incorrect. The Khadar is composed of **newer alluvium** and forms the flood plains along the river banks. A new layer of alluvium is deposited by river flood almost every year. These deposits are normally confined to the vicinity of the present river channels. **The clays have less kankar, and the organic remains entombed in them belong to still living species. .**

Statement c is correct. The Terai is a 15-30 km wide marshy tract in the south of Bhabar running parallel to it. **It is marked by the re-emergence of the underground streams of the Bhabar belt.** The re- emerged water converts large areas along the rivers into ill-drained marshy lands of excessive dampness covered with thick forests giving shelter to a variety of wild life.

The Tarai is more marked in the eastern part than in the west because the eastern parts of the **plain receive higher amount of rainfall than their western counterparts.** Most of the Tarai land, especially in **Punjab, Uttar Pradesh and Uttarakhand**, has been reclaimed and turned into agricultural land which gives good crops of sugarcane, rice and wheat.

Statement d is incorrect. The Bhangar (or Bangar) is composed of **old alluvium** of the Middle Pleistocene age and forms the alluvial terrace above the level of flood plains. **It is often impregnated with calcareous concretions known as kankar.**

Remnants of the Bhangar are eroded by every change in the direction of river channels, and are being levelled down by their meandering tendencies. It mostly occupies the Pleistocene terrace dating back to the Middle and Upper Pleistocene periods.

191. Solution: (a)

Exp) Option a is the correct answer.

Teak is the most dominant species **of Tropical Moist Deciduous Forest. Tropical Deciduous Forest** are the most widespread forests of India. They are also called the monsoon forests and spread over the region receiving rainfall between 200 cm and 70 cm. Trees of this forest type shed their leaves for about six to eight weeks in dry summer. On the basis of the availability of water, **these forests are further divided into moist and dry deciduous.** The former is found in areas receiving rainfall between 200 and 100 cm. These forests exist, therefore, mostly in the eastern part of the country — northeastern states, along the foothills of the Himalayas, Jharkhand, West Odisha and Chhattisgarh, and on the eastern slopes of the Western Ghats. Teak is the most dominant species of this forest. Bamboos, sal, shisham, sandalwood, khair, kusum, arjun and mulberry are other commercially important species.

192. Solution: (b)

Exp) Option b is the correct answer.

The Wet Tropical Evergreen Vegetation is found in regions of very high annual rainfall exceeding 300 cm with a very brief dry season. Southern parts of Western Ghats of Kerala and Karnataka are very wet. It resembles the equatorial vegetation.

Option b is correct. Features of the Wet Tropical Evergreen Vegetation:

- Though these **forests are dense** and have lofty evergreen trees, often as high as 60 metres and above, **grass is almost absent.**
- Undergrowth is very dense and thick.
- The wood of these trees is very hard and heavy to work with.
- The **number of vegetal species per unit area is too large** to exploit them commercially.
- **Mahogony, cinchona, bamboos and palms** are typical species of plants found in these forests.
- **North-eastern Hills** are known for this type of vegetation.
- This type of vegetal cover has been badly depleted due to over cutting of trees.

193. Solution: (b)

Exp) Option b is the correct answer.

The tropical evergreen forests usually occur in areas receiving more than 200 cm of rainfall and having a temperature of 15 to 30 degrees Celsius.

Options 1, 2 and 4 are correct : The Tropical Wet Evergreen forests are found along the western side of the Western

Ghats (500 to 1370 metres above sea level), some regions in the Purvanchal hills running from Northeast to Southwest direction and in the Andaman and Nicobar Islands.

Option 3 incorrect: Tropical thorn forests are found in arid and semi-arid regions of western Rajasthan. These extend from western Indo -Park border and gradually merge with the dry deciduous mixed forests of the Aravalli hills and the south-eastern plateau.

194. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is incorrect: The Alpine forests occur **along the Himalayas at altitudes ranging between 2,900 to 3,500 m or even up-to 3800 m above sea level,** (But the average height of Eastern Ghats is only about 1,822 m) depending upon the location and the variety of species.

Statement 2 is correct: Silver fir, junipers, pines and birches are the common trees of these forests. However, they get progressively stunted as they approach the snow-line. Ultimately, through shrubs and scrubs, they merge into the Alpine grasslands. These are used extensively for grazing by nomadic tribes,

Statement 3 is incorrect: They form only 2.1 percent of the Total Forest Area in India.

195. Solution: (d)

Exp) Option d is the correct answer.

Tropical Evergreen forests are one of the most dominant parts of Natural vegetation in India. They flourish in areas that have rainfall of over 200 cm.

Option 1 is correct: Mahogany and Rosewood trees are found in the **tropical evergreen forest**. The tropical evergreen forest is also called tropical rain forest. The Mahogany is a reddish-brown, straight-grained timber possessing 3 tropical hardwood species belonging to the genus Swietenia.

Option 2 is incorrect: Sandalwood is a dry deciduous forest species native to China, India, Indonesia, Australia, and the Philippines.

Option 3 is incorrect: Babul is found in tropical thorn forests predominantly in Rajasthan, south-western Punjab, western Haryana, Kutch and neighboring parts of Saurashtra.

196. Solution: (c)

Exp) Option c is the correct answer.

Precipitation and sunlight are the two major deciding factors for the development of thick forests. Where there is more rainfall and more sunlight, the vegetation is denser. The western slopes of the Western Ghats are covered with thick forests as compared to the eastern slopes since the eastern slopes are on the leeward side of the Western Ghats and hence receive scanty rainfall. It is because the western slope gets much heavier rainfall than the eastern slope. Moisture-laden air moves eastwards across the Western Ghats during the monsoon season.

Important Tips

The slopes of the Western Ghats have thick forests and wildlife as the western Ghats receive more rainfall than the Eastern Ghats. The hills in the Western Ghats have an average elevation of about 2,695 meters while the hills of the eastern Ghats have an average elevation of 1,501 meters. Therefore, the hills of the western Ghats are higher than that of the Eastern Ghats. The southwest monsoon winds are blocked by the hills of the Western Ghats. Hence, the western Ghats receive more rainfall as compared to the eastern Ghats which receive scanty rainfall during the monsoon retreat by the end of November.

197. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: Meizotropis pellita, commonly known as Patwa, is a perennial shrub with restricted distribution that is endemic to Uttarakhand. The species is listed as 'critically endangered' based on its limited area of occupancy (less than 10 sq. km). The species is threatened by deforestation, habitat fragmentation and forest fires.

The essential oil extracted from the leaves of the species possesses strong antioxidants and can be a promising natural substitute for synthetic antioxidants in pharmaceutical industries.

Statement 2 is correct: Fritillaria cirrhosa (Himalayan fritillary) is a perennial bulbous herb. It is found in the Himalayan Region.

In China, **the species is used for the treatment of bronchial disorders and pneumonia.** The plant is also a strong cough suppressant and source of expectorant drugs in traditional Chinese medicine.

Statement 3 is correct: Dactylorhiza hatagirea (Salampanja) is a perennial tuberous species endemic to the Hindu Kush and Himalayan ranges of Afghanistan, Bhutan, China, India, Nepal, and Pakistan. It is threatened by habitat loss, livestock grazing, deforestation, and climate change, the species is listed as 'endangered'.

It is extensively used in Ayurveda, Siddha, Unani and other alternative systems of medicine to cure dysentery, gastritis, chronic fever, cough and stomach aches.

198. Solution: (c)

Exp) Option c is the correct answer.

Sholas are temperate forests that are found in the higher elevations of the Nilgiris, Anaimalai, and Palani hills in South India. These forests are characterized by short, stunted trees that are evergreen. The trees in shola forests are adapted to the cool, moist conditions of the high altitudes.

199. Solution: (b)

Exp) Option b is the correct answer.

Mangroves are salt-tolerant plants adapted to survive in intertidal zones with high salinity levels.

They possess specialised features like specialised roots, glands, and metabolic processes to regulate salt uptake and excretion.

Statement 1 is incorrect: Mangroves can grow in fresh water. For example- World's first freshwater mangrove forest has been discovered on Brazilian Coast along the Amazon Delta.

Statement 2 is correct: Mangroves are also known to absorb and store large amounts of carbon dioxide from the atmosphere. Mangroves are considered significant carbon sinks. They absorb large amounts of carbon dioxide from the atmosphere through photosynthesis and store it in their biomass and sediments. This plays a crucial role in mitigating climate change.

Statement 3 is correct: Mangroves can play an important role in reducing heavy metal pollution in water by taking up and storing heavy metal. Their **roots and sediments have the ability to absorb and accumulate certain heavy metals**, thus playing a crucial role in filtering heavy metal pollution from water. For example, in a recent research scientists found that Rhizophora stylosa (a mangrove species) absorbed high amounts of cadmium (Cd) in Yingluo Bay (China).

200. Solution: (d)

Exp) Option d is the correct answer.

Medicinal plants refer to a variety of plants used for medicinal purposes and also it may be used as a component for producing modern drugs.

Pair 1 is correct: Kachnars are used to **cure asthma and ulcers.** The buds and roots are good for digestive problems.

Pair 2 is correct: Arjun is used to treat earache. The fresh juice of leaves is a cure for earache. It is also used to regulate blood pressure.

Pair 3 is correct: Sarpagandha is laden with alkaloids, which hold strong sedative traits that positively influence an agitated brain, mind and central nervous system. **It is hence a very useful therapy for insomnia, as it pacifies the mind and promotes deep sleep at night.** Moreover, it lowers mental stress and tension, thus tackling bouts of anxiety, nervousness, panic attacks and soothing the brain and mind for peaceful sleep.

Pair 4 is correct: Himalayan fritillary is an herb and is used for the treatment of **pneumonia**. The plant is also a strong cough suppressant and a source of expectorant drugs (used to lubricate human's airway) in traditional Chinese medicine.

Important Tips

Sarpagandha	: Used to treat blood pressure; it is found only in India.
Jamun	: The juice from ripe fruit is used to prepare vinegar which is carminative and diuretic, and has digestive properties. The powder of the seed is used for controlling diabetes.
Arjun	: The fresh juice of leaves is a cure for earache. It is also used to regulate blood pressure.
Babool	: Leaves are used as a cure for eye sores. Its gum is used as a tonic.
Neem	: Has high antibiotic and antibacterial properties.
Tulsi Plant	: Is used to cure cough and cold.
Kachnar	: Is used to cure asthma and ulcers. The buds and roots are good for digestive problems.

Identify more medicinal plants in your area. Which plants are used as medicines by local people to cure some diseases?

Source : Medicinal Plants by Dr. S.K. Jain, 5th edition 1994, National Book Trust of India

201. Solution: (a)

Exp) Option a is the correct answer.

Tropical evergreen forests are **dense, multi-layered forests** that contain many types of **plants and animals.** They are found in areas that receive **heavy rainfall (more than 200 cm annual rainfall).** The trees in these forests **do not shed their leaves** and **they always appear to be green.**

Option 1 is incorrect- The **Babul tree species (Vachellia nilotica)** is commonly located in **thorn forests**, alternatively referred to as **dry forests or tropical savannas**. Thorn forests are distinguished by a **sparse tree population, scrubby vegetation, and elongated thorns on the plants.** Typically situated in arid areas with low rainfall and elevated temperatures, such as regions in **India, Africa, and Australia.**

Option 2 is incorrect- The **Neem tree (Azadirachta indica)** is a versatile and resilient species found in dry deciduous and **thorn forests**. Neem trees are widely distributed throughout **tropical and subtropical regions**, including **India, Africa, and Southeast Asia**. They play a vital role in the ecology of tropical thorn forests and are also valued for their **medicinal and economic properties.**

Option 3 is correct- Rosewood (Dalbergia sissoo) is found in **tropical evergreen forests**. Rosewood isn't a single species, but rather a **group of trees** belonging primarily to the **genus Dalbergia**. These trees are native to various tropical and subtropical regions, including **South America, Africa, India, and Southeast Asia**. Each region boasts its **unique rosewood varieties**, distinguished by subtle differences in **color, grain pattern, and density**. Indian Rosewood, also known as **Sheesham**, offers a vibrant **reddish-brown hue** and **exceptional strength**. It's a popular choice for **furniture and decorative items**.

202. Solution: (a)

Exp) Option a is the correct answer.

The Forest Conservation Act of 1980 is a landmark legislation to regulate the diversion of forest land for non-forestry purposes. Its primary objective is to ensure the protection, conservation and sustainable management of forests by restricting unauthorized deforestation and promoting afforestation efforts. The act also provides for penalties for violating its provisions.

Statement 1 is correct: The Forest Conservation Act of 1980 mandates that any diversion of forest land by the State Government or any other respective authority for non-forestry purposes, requires prior approval from the Central government. This provision aims to regulate and minimize the diversion of forest land to protect the environment and biodiversity.

Additionally, whenever a forest land is to be diverted for non-forestry purposes, the equivalent non forest land has to be identified for compensatory afforestation and funds for raising compensatory afforestation are to be imposed.

Statement 2 is incorrect: It was **the Indian Forest Act of 1878** that for the first time introduced these concepts and classified forests into three categories; **Reserved, protected and village forest.**

Statement 3 is incorrect: The power to make rules and regulations under the Forest Conservation Act of 1980 lies with the Central government, not with the respective State governments. The Act empowers the Central government to make rules and guidelines for the conservation, protection, and management of forests across the country.

Statement 4 is correct: The Forest Conservation Act of 1980 contains provisions regarding the constitution of the Forest Advisory Committee. This committee is a statutory body, and it advises the Central government on matters related to the implementation of the Act, including proposals for the diversion of forest land for non-forestry purposes and measures for the conservation of forests.

203. Solution: (a)

Exp) Option a is the correct answer

Statement 1 is correct: Indian forest is dominated by hardwood trees like Teak, Sal, Mahogany etc. Though they are excellent for making furniture, have limited suitability for pulpwood production and affect commercial viability for paper and pulpwood industries.

Statement 2 is incorrect: India's average timber yield, at 0.5m^3/ha, is significantly lower than the global average of 3-4m^3/ha according to Forest Survey of India.

Statement 3 is incorrect: The Forest Survey of India's latest report highlights a worrying trend. The 2021 report reveals a total decrease of 22.62 square kilometers in forest cover across the country's 52 tiger reserves and the Gir Lion Conservation Area over the past decade.

204. Solution: (d)

Exp) Option d is the correct answer.

Option d is correct: Strychnine, Aconite & Datura are poisonous substances obtained in Indian Forest.

1. **Aconite plants** are highly toxic due to the presence of diterpenoid alkaloids, including aconitine, mesaconitine, and hypaconitine. These alkaloids are powerful neurotoxins that affect the nervous system.
2. **Datura plants** are highly toxic due to the presence of tropane alkaloids, including atropine, hyoscyamine, and scopolamine. These alkaloids are powerful anticholinergics, which means they block the effects of the neurotransmitter acetylcholine.
3. **Strychnine** is a poisonous alkaloid that is obtained from seeds of the nux vomica tree (S. nux-vomica) and related plants of the genus Strychnos.

Important Tips

Alkaloids are naturally occurring organic compounds that contain basic nitrogen atoms. They are typically produced by plants, although some alkaloids are found in animals, fungi, and bacteria as well.

205. Solution: (c)

Exp) Option c is the correct answer.

A Reserve Forest is a designated area of land that is protected and managed by the respective state governments under the Indian Forest Act of 1927. Reserve forests are established to conserve biodiversity, protect wildlife habitats, maintain ecological balance, and ensure sustainable use of forest resources.

Statement 1 is correct: Reserved forests cover approximately 54% of total recorded forest area in India.

Statement 2 is correct: Rights to activities such as grazing cattle or hunting and public entry are banned in these forests unless specific orders are issued otherwise.

Unlike protected forests, where such activities are sometimes allowed for communities living on the fringes of the forest, who sustain their livelihood partially or wholly from forest resources or products.

Important Tips

Reserved forests in India are often raised to the status of wildlife sanctuaries, which in turn may be upgraded to the position of national parks. Like for instance, Sariska National Park was announced a reserved forest of India in the year 1955, later upgraded to the position of wildlife sanctuary in the year 1958, and eventually becoming a tiger reserve in the year 1978. It became a national park in the year 1992.

206. Solution: (c)

Exp) Option c is the correct answer.

Non-Timber Forest Produce (NTFP), commonly referred to as Minor Forest Produce (MFP) are an important source of livelihood for many tribal communities living in forest areas. Forest dwellers have ownership and governance rights over MFP through acts like the Panchayat Extension to Scheduled Areas (PESA) Act, 1996, and the Forest Rights Act, 2006.

Option 1,2,3 and 5 are correct: The Forest Rights Act, 2006, defines Minor Forest Produce (MFP) as all non-timber forest items of plant origin. This encompasses a wide range of products such as **bamboo,** brushwood, stumps, **canes,** Tusser, **Cocoon**, honey, waxes, Lac, tendu/kendu leaves, **medicinal plants and herbs**, roots, tuber, and similar items.

The Indian Forest Act 1927, earlier categorized **bamboo and cane as "trees" but** with the **Forest Rights Act, 2006** classified them as Minor Forest Produce (MFP).

Option 4 is incorrect: The Forest rights act, 2006, **does not recognize timber** as Minor Forest Produce (**MFP**). Furthermore, the act defines non timber forest produce as MFP and therefore **timber is not an MFP.**

207. Solution: (c)

Exp) Option c is the correct answer.

As per the India State of Forest Report 2023 (ISFR 2023), the total mangrove cover in India is 4,991.68 km^2, which constitutes 0.15% of the country's total geographical area. The mangrove cover is categorized into three density classes: (i) Very Dense Mangrove: 1,463.97 km^2 (29.33%), (ii) Moderately Dense Mangrove: 1,500.84 km^2 (30.07%), (iii)

Open Mangrove: 2,026.87 km² (40.60%). Compared to the 2021 assessment, there has been a net decrease of 7.43 km² in the country's total mangrove cover.

As per the **India State of Forest Report 2023**, the **mangrove cover** for the given states is as follows: **Gujarat** has the highest mangrove cover at **1,200.45 km²**, followed by **Andhra Pradesh** with **408.42 km²**. **Maharashtra** ranks next with **302.70 km²**, while **Odisha** has a mangrove cover of **257.51 km²**.

Hence the correct decreasing order of states is c: 2-1-4-3 i.e. Gujarat > Andhra Pradesh > Maharashtra > Odisha.

208. Solution: (b)

Exp) Option b is the correct answer.

Tropical Wet Evergreen Forests are dense rainforests thriving in regions with annual rainfall exceeding 250 cm, temperatures ranging from 25°C to 27°C, and humidity levels above 77%. These forests experience a brief dry season, and due to the high heat and moisture, trees retain their leaves year-round, making them evergreen.

The timber from these forests is fine-grained, hard, and durable, making it commercially valuable. Important tree species include Mesua, **White Cedar**, Calophyllum, Toon, Dhup, Palaquium, Hopea, and Jamun in the Western Ghats, while species like **Gurjan,** Jamun, Mesua, Agar, Muli, and Bamboo are found in the Himalayan region.

However, **Mahua** is characteristic plant specie of **Tropical Moist Deciduous Forests.**

209. Solution: (a)

Exp) Option a is the correct answer.

Tree Cover refers to tree patches **smaller than one hectare** that exist **outside legally recorded forests**. These may include **scattered trees, plantations, gardens, orchards, and roadside trees**. For example, coconut plantations in Kerala, roadside trees in Delhi, mango orchards in Uttar Pradesh.

Forest Cover includes **all areas larger than one hectare** with **at least 10% canopy density**, regardless of whether the land is legally designated as a forest. It can include both **natural forests and plantations**. For example, dense Sal forests in Madhya Pradesh, mangrove forests in the Sundarbans, plantations in Assam.

Option b is incorrect. Tree Cover is not just scattered trees; it also includes clusters of trees in plantations, orchards, and gardens. Forest Cover is not limited to dense, continuous forests—it includes both **dense and open forests**, as long as the area is **greater than one hectare with at least 10% canopy density.**

Option c is incorrect. Tree Cover includes both natural and man-made trees outside forest areas (e.g., agricultural plantations, roadside trees). **Forest Cover includes both natural forests and large-scale plantations**, as long as the area is **more than one hectare and meets the 10% canopy density requirement.**

Option d is incorrect. This statement **reverses the correct definitions. Tree Cover refers to tree patches smaller than one hectare**, while **Forest Cover refers to areas larger than one hectare with at least 10% canopy density.**

210. Solution: (b)

Exp) Option b is the correct answer.

Meghalaya is home to Mawsynram and Cherrapunji, which receive **the highest annual rainfall in the world** due to **orographic lifting** caused by the Khasi Hills. Moist air from the **Bay of Bengal is forced to rise over the hills**, leading to **heavy monsoonal rainfall.**

- Meghalaya is **one of India's most densely forested states**, with **over 76% of its land under forest cover**, as per the **India State of Forest Report (ISFR)**. The forests are **dominated by subtropical and tropical evergreen species**, supporting rich biodiversity, including elephants, clouded leopards, and red pandas.
- The state has **rich limestone reserves**, which support the **cement industry. Coal deposits** in Meghalaya are **found in regions like Jaintia Hills**, though mining has faced restrictions due to environmental concerns.
- The **living root bridges of Meghalaya**, constructed by indigenous tribes using rubber fig tree roots, are a **globally recognized example of bioengineering.**

211. Solution: (d)

Exp) Option d is the correct answer.

Baobab Trees are long-lived deciduous trees, ranging from 5 to 30 meters (20 to 100 feet) tall, **with broad trunks and compact tops. These are also Known as the "upside-down tree" for their unusual appearance.** There are nine types of baobab trees, mostly in Africa, Madagascar, and a few in Australia. **In India, they are mainly found in Mandu, Madhya Pradesh, where the Bhil tribe has historically preserved them.**

212. Solution: (a)

Exp) Option a is the correct answer.

India's forest cover is diverse, consisting of various types of vegetation classified based on climate, soil, and rainfall patterns. Among them, Tropical Dry Deciduous, Tropical Moist Deciduous, Tropical Wet Evergreen, and Tropical Thorn Forests contribute differently to the total forest area. The correct descending order based on their share in India's total forest cover is as follows:

1. **Tropical Dry Deciduous Forests cover the largest area of 2,80,580 km²**, making them the most widespread forest type in the country. These forests are commonly found in Madhya Pradesh, Chhattisgarh, Maharashtra, Odisha, and parts of Uttar Pradesh and Rajasthan. Characterized by trees like Tendu, Palas, Amalatas, and Axlewood, they shed their leaves during dry seasons to conserve water.
2. **Tropical Moist Deciduous Forests rank second in terms of area, covering 1,33,187 km².** These forests are found in northeastern states, along the foothills of the Himalayas, the eastern coastal plains, and parts of central India. The dominant tree species include Sal,

Teak, Sandalwood, and Mahua, which remain green for most of the year.

3. **Tropical Wet Evergreen Forests have a significantly smaller share, covering 23,888 km².** These dense, multi-layered forests thrive in high-rainfall areas such as the Western Ghats, northeastern states (Assam, Arunachal Pradesh, Nagaland), and the Andaman & Nicobar Islands. Known for their towering trees like Mahogany, Ebony, Rosewood, and Rubber trees, they receive over 200 cm of annual rainfall and remain green throughout the year.
4. **Tropical Thorn Forests occupy the smallest area of 13,755 km² among the given options** and are primarily found in arid and semi-arid regions of Rajasthan, Gujarat, Punjab, Haryana, and parts of Madhya Pradesh. These forests are characterized by thorny trees and shrubs like Acacia, Babool, Cactus, and Date Palm, which are well-adapted to extreme drought conditions.

213. Solution: (a)

Exp) Option a is the correct answer.

The Himalayan ranges show a range of vegetation from the tropical to the alpine, which changes with altitude. The eastern Himalayas have more tropical nature, a greater variety of Oaks and Rhododendrons while more conifers are found in the western Himalayas.

Options 1 and 2 are correct. Oaks trees form the backbone of the temperate moist forest biome occurring between 1,500 m and 2,700 m in the Himalayas.

Oaks in the genus Quercus of Fagaceae family (beech family) constitute an important group of forest trees and occupy a sizeable area in the Himalayas. There are 16 species of oaks growing in India, ten in eastern Himalayas and six in the western Himalayas.

Rhododendrons are flowering trees found at altitudes ranging from 1,500 m to over 5,000 m above sea level. They are abundant in the Eastern Himalayan region, especially Sikkim and Arunachal Pradesh.

Option 3 is incorrect. Sandalwood is an evergreen tree which mostly grows in the dry, deciduous forests of Karnataka, Tamil Nadu, Kerala and Andhra Pradesh, not generally in the Himalayas.

5.5. Soils

214. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is incorrect: Alkaline soil is referred to by some gardeners as "sweet soil." The pH level of alkaline soil is above 7, and it usually contains a great deal of sodium, calcium, and magnesium. Since alkaline soil is less soluble than acidic or neutral soil, availability of nutrients is often limited. It is due to this that stunted growth and nutrient deficiency are common.

Statement 2 is correct: As a result of soil alkalinity, **soil fertility is reduced.** Soil alkalinity or salinity is a condition that results from the accumulation of soluble salts in soil. An excessive accumulation of salts in the soil profile causes a decline in agricultural productivity. Soil salinity affects plants directly through the reduced osmotic potential of the soil solution and the toxicity of specific ions such as boron, chloride, and sodium.

Statement 3 is incorrect: Soil alkalinity limits the choice of crops to only salt tolerant crops. Those crops which are tolerant towards the salt levels in the soil can be grown in alkaline soils.

215. Solution: (b)

Exp) Option b is the correct answer

Mountain soils are found in mountainous regions and can belong to many known soil types.

Statement 1 is correct: Mountain soils tend to be shallow because they are formed from the weathering of the parent rock material and the accumulation of organic matter on steep slopes. Erosion also plays a significant role in limiting the depth of mountain soils.

Statement 2 is correct: Mountain soils often have a high organic matter content, especially in forested areas, where the accumulation of leaf litter and other plant debris contributes to the formation of humus-rich topsoil layers. The cool temperatures and high moisture content found in many mountain regions can slow down the decomposition of organic matter, leading to a build-up of organic material.

Statement 3 is incorrect: The nutrient content of mountain soils can vary greatly depending on factors such as the parent rock material, the slope, and the vegetation type. In general, nutrient availability tends to be lower in mountain soils due to the combination of steep slopes, high rainfall, and shallow soil depth, which can lead to increased leaching of nutrients and limited nutrient cycling.

Statement 4 is correct: Mountain soils are often acidic due to the weathering of parent rock material, which can release acidic components into the soil. Additionally, the high rainfall in many mountainous regions can lead to the leaching of basic cations, further contributing to soil acidity. The decomposition of organic matter, especially in forested areas, can also produce acidic compounds that contribute to soil acidity.

216. Solution: (d)

Exp) Option d is the correct answer.

On the basis of genesis, colour, composition and location, the soils of India have been classified into multiple types. Few of them are discussed below:

Option 1 is correct: Black soil covers most of the Deccan Plateau which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh and some parts of Tamil Nadu. In the upper reaches of the Godavari and the Krishna, and the north western part of the Deccan Plateau, the black soil is very deep. These soils are also known as the 'Regur Soil' or the 'Black Cotton Soil'. Chemically, the black soils are rich in lime, iron, magnesia and alumina. They also contain

potash. But **they lack in phosphorous, nitrogen and organic matter.** The colour of the soil ranges from deep black to grey.

Option 2 is correct: Red soil develops on crystalline igneous rocks in areas of low rainfall in the eastern and southern part of the Deccan Plateau. Red loamy soil is found along the piedmont zone of the Western Ghat. Yellow and red soils are also found in parts of Odisha and Chattisgarh and in the southern parts of the middle Ganga plain. The soil develops a reddish colour due to a wide diffusion of iron in crystalline and metamorphic rocks. It looks yellow when it occurs in a hydrated form. **These soils are generally poor in nitrogen, phosphorous and humus.**

Option 3 is correct: Arid soils range from red to brown in colour. They are generally sandy in structure and saline in nature. In some areas, the salt content is so high that common salt is obtained by evaporating the saline water. Due to the dry climate, high temperature and accelerated evaporation, they lack moisture and humus. **Nitrogen is insufficient and the phosphate content is normal.**

Option 4 is correct: The laterite soils develop in areas with high temperature and high rainfall. These are the result of intense leaching due to tropical rains. With rain, lime and silica are leached away, and soils rich in iron oxide and aluminium compound are left behind. Humus content of the soil is removed fast by bacteria that thrives well in high temperature. **These soils are poor in organic matter, nitrogen, phosphate and calcium,** while iron oxide and potash are in excess.

217. Solution: (c)

Exp) Option c is the correct answer.

Laterite soils are mostly the **end products of weathering.** They are formed under conditions of **high temperature and heavy rainfall with alternate wet and dry periods**. Heavy rainfall promotes **leaching (nutrients get washed away by water)** of soil whereby lime and silica are leached away, and soil rich in oxides of iron and Aluminum compounds is left behind. They **harden greatly on losing moisture**. Laterite soils are red in color due to little clay and more gravel of red sandstones. The continuous stretch of laterite soil is found on the summits of Western Ghats at 1000 to 1500 m abovemean sea level, Eastern Ghats, the Rajmahal Hills, Vindhyan, Satpuras and Malwa Plateau. They are well developed in south Maharashtra, parts of Karnataka etc. and are widely scattered in other regions. **Laterite soils lack fertility** due to **intensive leaching.** When manured and irrigated, some laterites are suitable for growing **plantation crops** like tea, coffee, rubber, cinchona, coconut, arecanut, etc. In some areas, these soils support **grazing grounds and scrub forests.**

218. Solution: (d)

Exp) Option d is the correct answer

Statement 1 is correct: Contour ploughing is a farming practice where plowing and/or planting is done across a slope following its elevation contour lines. These contour lines create a water break which reduces the formation of rills and gullies during times of heavy precipitation, allowing more time for the water to settle into the **soil. In contour ploughing, the ruts made by the plow run perpendicular rather than parallel to the slopes, generally furrows that curve around the land and are level.**

Statement 2 is correct: Contour ploughing is a well-established agronomic measure that contributes to soil and water conservation. The soil is ploughed along the contour. This decreases the velocity of runoff and thus soil erosion by concentrating water in the downward furrows. Contour ploughing purposely builds a barrier against rainwater runoff which is collected in the furrows.

Statement 3 is correct: Contour ploughing has been proven to reduce fertilizer loss which would lead to less usage of fertiliser. Because contour cropping reduces fertility loss through erosion and leaching, it reduces the need for fertilizer application. Reduced demand for fertilizer means reduced production costs.

219. Solution: (c)

Exp) Option c is the correct answer.

Indian soils, as in other parts of the world, reflect a combination of factors that have contributed to their formation.

Option 1 is incorrect: India is not situated on an active volcanic belt or in proximity to any significant volcanic activity. The Deccan Plateau, which is a result of volcanic eruptions that occurred millions of years ago, is an exception. **However, the volcanic ash from these eruptions has been mostly weathered and eroded over time, leading to its minimal presence in Indian soils**. In contrast, countries like Japan, Indonesia, and Iceland have higher volcanic ash content in their soils due to their location along active volcanic belts.

Whereas Laterite soils are rich in **bauxite or ferric oxides.** They are very **poor** in lime, magnesia, **potash and nitrogen.**

Option 2 is correct: The **peninsular** region is primarily composed of ancient crystalline rocks such as granites, gneisses, and schists, which are rich in iron and other minerals. **These rocks, over time, have weathered to form soils that are rich in iron oxide.**

Option 3 is correct: Peaty and marshy soils are soils with **large amounts of organic matter** and considerable amounts of soluble salts. **The most humid regions have this type of soil. They are black, heavy and highly acidic.**

220. Solution: (a)

Exp) Option a is the correct answer.

As the name suggests, forest soils are formed in the forest areas where sufficient rainfall is available. The soils vary in structure and texture depending on the mountain environment where they are formed. They are loamy and silty on valley sides and coarse-grained on the upper slopes. In the snow-bound areas of the Himalayas, they experience denudation and are acidic with low humus content. The soils found in the lower valleys are fertile. It is evident from the foregoing discussions that soils, their texture, quality, and

nature are vital for the germination and growth of plants and vegetation including crops. Soils are living systems. Like any other organism, they too develop and decay, get degraded, and respond to proper treatment if administered in time. These have serious repercussions on other components of the system of which they themselves are important parts.

221. Solution: (c)

Exp) Option c is the correct answer

Statement 1 is correct: Among the in-situ soils of India, black soils are found in lava-covered areas. These soils are often referred to as Regur soils or "black cotton soils," since cotton has been the most common traditional crop in these areas. Black soils are derivatives of trap lava and are spread mostly across interior Gujarat, Maharashtra, Karnataka, and Madhya Pradesh on the Deccan lava plateau and the Malwa Plateau, where there is both moderate rainfall and underlying basaltic rock. Thus, they are mostly found in the Peninsular Plateau of India.

Statement 2 is correct: Black soil covers most of the Deccan Plateau which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh, and some parts of Tamil Nadu Chemically, the black soils are rich in lime, iron, magnesia, and alumina. They also contain potash. But they lack phosphorus, nitrogen, and organic matter. The color of the soil ranges from deep black to grey.

Statements 3 is correct and 4 is incorrect. The black soils are generally clayey, deep and impermeable. They swell and become sticky when wet and shrink when dried. So, during the dry season, these soils develop wide cracks. Thus, there occurs a kind of 'self-ploughing'. Because of this character of slow absorption and loss of moisture, the black soil retains the moisture for a very long time, which **helps the crops, especially, the rain fed ones, to sustain even during the dry season.**

222. Solution: (b)

Exp) Option b is the correct answer

Statement 1 is incorrect: The Red soil develops on crystalline igneous rocks in areas of low rainfall in the eastern and southern parts of the Deccan Plateau. The laterite soils develop in areas with elevated temperatures and high rainfall. These are the result of high leaching due to tropical rains.

Statement 2 is correct: laterites are generally not suitable for cultivation. This soil is deficient in fertility because of high leaching caused by high rainfall. However, the application of manure is required for making the soil fertile for cultivation. On the other hand, the Red Soils generally occur in areas of low rainfall and are free from leaching. So, red soils are generally more fertile when compared to the laterite soils.

Statement 3 is correct: Fine-grained red and yellow soils are normally fertile, whereas coarse-grained soils found in dry upland areas are poor in fertility. They are poor in nitrogen, phosphorous, and humus. While in laterite soil, Humus content of the soil is removed fast by bacteria that thrive well in elevated temperature. These soils are poor in organic matter, nitrogen, phosphate, and calcium, while iron oxide and potash are in excess.

Important Tips

Laterite has been derived from the Latin word 'Later' which means brick. The laterite soils develop in areas with hot temperatures and high rainfall. These are the result of intense leaching due to tropical rains. With rain, lime, and silica leak away, and soils rich in iron oxide and aluminum compound are left behind. The Humus content of the soil is removed fast by bacteria that thrives well in elevated temperature and moisture. These soils are poor in organic matter, nitrogen, phosphate, and calcium, while iron oxide and potash are in excess. Hence, laterites are not suitable for cultivation; however, the application of manures and fertilizers are required for making the soils fertile for cultivation. Red laterite soils in Tamil Nadu, Andhra Pradesh and Kerala are more suitable for crops like cashew nut. Laterite soils are widely cut as bricks for use in house construction. This soil has developed in the higher areas of the Peninsular plateau. The laterite soils are commonly found in Karnataka, Kerala, Tamil Nadu, Madhya Pradesh and the hilly areas of Odisha and Assam.

223. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is incorrect: Saline Soils occur in arid and semi-arid regions, and in waterlogged and swampy areas. **Peaty Soils are found in the areas of heavy rainfall and high humidity,** where there is a good growth of vegetation.

Statement 2 is incorrect: Peaty Soils are found in the areas of heavy rainfall and high humidity, where there is a good growth of vegetation. Thus, large quantity of dead organic matter accumulates in these areas, and **this gives a rich humus and organic content to the soil.** Organic matter in these soils may go even up to 40-50 per cent.

Statement 3 is incorrect: Saline soils contain a larger proportion of sodium, potassium and magnesium, and thus, they are infertile, **and do not support any vegetative growth.** Peaty Soils

are found in the areas of heavy rainfall and high humidity, **where there is a good growth of vegetation.**

224. Solution: (a)

Exp) Option a is the correct answer.

Irrigation at optimal level is very essential for the agriculture. When used in excess, it can lead to the accumulation of salts in the topsoil, a phenomenon known as soil salinization.

Statement-I is correct: India's agricultural heartland, known for its fertile **alluvial plains, faces a growing threat of soil salinization**. In areas with intensive cultivation and excessive irrigation, these once-productive lands are becoming increasingly saline due to excessive irrigation, overuse of chemical fertilisers and overexploitation of groundwater etc.

Statement-II is correct, and Statement II is the correct explanation for statement I: As water is **applied in excess,**

it infiltrates the soil and raises the water table. This brings dissolved salts, naturally present in the soil, closer to the surface. The sun's heat causes water to evaporate and creates a suction force that draws water and dissolved salts upwards through the soil profile, a process known as **capillary action.** Hence this explains why excessive irrigation leads to salinization of alluvial soils.

225. Solution: (c)

Exp) Option c is the correct answer.

Peaty soils are formed through the accumulation of **partially decomposed organic matter** in waterlogged environments with limited oxygen availability. It occurs widely in the northern part of Bihar, southern part of Uttaranchal and the coastal areas of West Bengal, Orissa and Tamil Nadu.

Statement 1 is correct: Peaty soils are found mainly in the areas of high temperature and high humidity, which facilitates the **accumulation of organic matter** due to the slow decomposition of plant material in waterlogged conditions.

Statement 2 is correct: Peaty soils are indeed rich in humus and organic content (40-50% of the soil). This is because they are formed from the decomposition of organic matter in waterlogged environments with **limited oxygen, hindering complete decomposition**. This leads to the accumulation of partially decomposed organic matter, known as peat, which gives the soil its characteristic dark colour and high organic content.

226. Solution: (d)

Exp) Option d is the correct answer.

Laterite soils exhibit deficiencies in organic matter, nitrogen, phosphate, and calcium, while possessing an excess of iron oxide and potash. Consequently, these soils are deemed unsuitable for cultivation. However, the application of manures and fertilisers will enhance the soil fertility for agricultural purposes.

Statement-I is incorrect: Laterite soils are rich in iron oxide. The intense weathering process responsible for their formation concentrates iron oxides and aluminium oxides in the soil, giving them their characteristic **reddish-brown colour.** However, laterite soils are also typically **deficient in organic matter and humus content** due to the leaching process that removes these components.

Statement-II is correct: Laterite soils are primarily formed in regions with high rainfall and high temperatures. The **intense heat and abundant rainfall** accelerate the process of chemical weathering, leading to the **leaching of soluble elements like silica and calcium, while leaving behind iron and aluminium oxides.** Further, **humus content of the soil is removed fast by bacteria that thrives well in high temperatures.**

227. Solution: (c)

Exp) Option c is the correct answer.

Soil alkalinity and soil salinity are both characteristics of soil that can significantly impact plant growth and agricultural productivity. Saline soil contains high contents of soluble salts. Sodium salts are predominant in saline soil. In addition, K+, Ca2+, Mg2+ and Cl– are also responsible for the salinity of the soil. Hence, it has a basic pH range; 7 – 8.5.

Alkaline soils are clay soils that have a pH greater than 8.5. The high pH is due to the high levels of sodium, calcium, and magnesium. sodium carbonate is the dominant component in alkaline soil

Statement 1 is correct: Over-irrigation can lead to both soil salinization and alkalization through various mechanisms. When soil is over-irrigated, excessive water percolates beyond the root zone, bringing dissolved salts closer to the surface through capillary action. As the water evaporates, salt accumulates on the soil surface, leading to salinization. Additionally, over-irrigation can cause waterlogging, creating anaerobic conditions that promote the reduction of sulfate to sulfide ions, which, upon exposure to air, can raise soil pH and contribute to alkalization.

Statement 2 is correct: Treating topsoil with gypsum can indeed help reduce alkalization of soil. Gypsum, which is a calcium sulfate compound, can effectively counteract soil alkalization caused by excessive irrigation or the presence of sulfide ions. When applied to alkaline soil, gypsum reacts with sodium carbonate, which is a common component contributing to soil alkalization, forming calcium carbonate and sodium sulfate. This reaction helps to neutralize soil pH and improve soil structure, promoting better nutrient availability and plant growth. Thus, gypsum application serves as a practical solution to mitigate soil alkalization and restore soil health in agricultural and landscaping contexts.

Important Tips

Soil salinization adversely affects plant growth by disrupting osmotic balance, limiting water uptake, and causing toxicity to plant cells. It can lead to reduced crop yields, soil degradation, and desertification if left unaddressed. Managing soil salinization involves strategies like improving drainage, using salt-tolerant crops, and leaching excess salts from the soil through proper irrigation practices.

228. Solution: (c)

Exp) Option c is the correct answer

Option a is incorrect: Alluvial soil, formed by layers of sediment deposited over millennia, this rich, fine-grained soil nourishes diverse ecosystems and supports some of the world's most productive agricultural lands.

Option b is incorrect: Laterite soil, characterized by its reddish hue and porous structure, arises from intense weathering in humid tropical regions. Comprised primarily of iron and aluminum oxides, this soil often exhibits low fertility due to nutrient leaching.

Option c is correct: Saline and alkaline soils are characterized by high salt content (saline) or excess alkalinity (alkaline), these soils can restrict plant growth and limit crop yields. **They are also known by names such as thur, kakar,**

chopan,reh, usar and karl.

Option d is incorrect: Peaty and marshy soils, characterized by high organic matter content and saturated conditions, play a crucial role in wetland ecosystems. Formed from partially decomposed plant material in waterlogged environments, they store significant carbon and provide unique habitats for specialized flora and fauna.

229. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: Laterite soils are typically deficient in nitrogen because they are highly leached and have a low organic matter content. Nitrogen is a highly mobile nutrient that can be easily lost from the soil through leaching and erosion. Laterite soils are also often found in areas with high rainfall, which further contributes to the loss of nitrogen.

Statement 2 is correct: Plantation crops like tea, coffee, rubber, cinchona, coconut, arecanut etc, can be grown on **laterite soils.**

Statement 3 is incorrect: Laterite soils are mainly found in western ghats, eastern ghats, Rajmahal hills, Vindhyas, Satpura and Malwa plateau. It is well developed in the states of Maharashtra, Karnataka, Telangana, Andhra Pradesh, Odisha, West Bengal, Kerala, Jharkhand, Assam and Meghalaya.

Important Tips

Laterite soils are typically deficient in lime (calcium carbonate) and magnesia (magnesium oxide). This is because laterite soils are formed through the intense weathering of rocks, which removes these nutrients from the soil.

230. Solution: (a)

Exp) Option a is the correct answer.

The destruction of the soil cover is described as soil erosion. Both the processes of soil formation and erosion by water and wind occur simultaneously. Typically, there is a natural equilibrium between these processes. However, recent disruptions in this balance have been caused by excessive water usage and unsustainable agricultural practices.

Option 1 is correct: Roughening refers to amending the bare soil surface with horizontal grooves running across the slope, stair stepping, or tracking with construction equipment; or by leaving slopes in a roughened condition by not fine grading them. **It aids the establishment of vegetative cover from seed, to reduce runoff velocity and increase infiltration, and to reduce erosion and provide for sediment trapping.** Surface roughening provides some instant erosion protection on bare soil while vegetative cover is being established. It is an inexpensive and simple erosion control measure.

Option 2 is incorrect: Monocropping leaves the soil vulnerable to erosion as there is no diversity in plant cover to protect the soil. On the other hand, **crop rotation is acknowledged as an effective method for controlling soil erosion.** Crop rotation involves planting different crops successively on the same land plot to enhance soil health and optimize nutrient levels. This nutrient enrichment improves the soil's ability to absorb water and reduces soil erosion.

Option 3 is incorrect: Contour bunding involves building embankments across/perpendicular to the slope (not parallel to the slope). Constructing embankments **across/ perpendicular** to the slope helps in trapping soil and water, thus reducing erosion by preventing the rapid movement of water down the slope.

Option 4 is incorrect: Intensive tillage has the potential to disrupt soil structure, leading to increased soil erosion. Tillage encompasses mechanical actions like digging, stirring, and overturning the soil for preparation. In contrast, **zero tillage** involves planting seeds directly into the soil **without prior disturbance,** thus not only **minimizing soil erosion but also reduces the need for irrigation.**

Note: Roughening and tilling both amend the soil but differ in depth and purpose. Roughening lightly disrupts the top layer to break up smoothness. Tilling digs deeper, turning the soil, breaking up compaction, and preparing a seedbed.

Option 5 is correct: Plants and crop residues act as a shield, absorbing some of the wind's force and preventing soil particles from being carried away. When **rows of crops are planted perpendicular to the prevailing winds, they are more successful at controlling wind erosion** compared to rows planted parallel to the wind direction.

231. Solution: (d)

Exp) Option d is the correct answer.

India is a land having enormous soil diversity. It contains alluvial soil, black soil, red and yellow soil, laterite soil, etc. Among the soils, alluvial soil is considered as one of the most fertile soils. The soil profile of India can be depicted as:

Statement 1 is correct: Alluvial soils cover around 15 lakh sq. km. area of India, that constitutes around **45% of the total land area of the country.** They are primarily found in the **Indo-Gangetic plains, along river valleys, and coastal plains.** These soils are **formed by the deposition** of silt, clay, and sand carried by rivers and streams, making them highly fertile and conducive to agriculture.

Statement 2 is incorrect: While alluvial soils are **generally fertile and support agricultural productivity,** their fertility is not primarily due to high nitrogen content. Instead, the fertility of alluvial soils is attributed to their **rich mineral composition, good drainage properties, and the deposition of nutrients carried by rivers over time.** The overall **proportion of nitrogen in the alluvial soils is less.** These soils are **rich in potash, phosphoric acid and alkaline substances.**

Statement 3 is correct: The alluvial soils vary in nature from sandy loam to clay. These soils are loamier and more clayey in the middle and lower Ganga plain and the Brahamaputra valley. The sand content in the Alluvial soils decreases from the west to east.

232. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is incorrect: Khadar soil is formed by the **deposition of newer alluvium**, which is renewed every year by the floods along the riverbanks. Bhangar soil is formed by the deposition of older alluvium, found away from the riverbanks, above the flood level. Therefore, Khadar soil is newer and more fertile than Bhangar soil, while Bhangar soil is older and less fertile than Khadar soil.

Statement 2 is incorrect: Khadar soil contains fewer lime nodules (kankar) compared to Bhangar soil. Lime nodules are more commonly found in Bhangar soil due to its older age and extensive weathering processes. Lime Nodules are more commonly found in Bhangar soil due to the leaching of calcium carbonate over time. Khadar soil, being younger, has fewer kankars.

Statement 3 is incorrect: Khadar soil is **more fertile than Bhangar** due to its newer sediments, richer organic matter content, and better drainage.

233. Solution: (d)

Exp) Option d is the correct answer

Statement I is correct: Laterite has been derived from the Latin word 'Later' which means brick. The laterite soils develop in areas with high temperature and high rainfall. **They are widely cut as bricks for use in house construction.**

Statement II is incorrect: Laterite soils are rich in iron oxide. The intense weathering process responsible for their formation concentrates iron oxides and aluminium oxides in the soil, giving them their characteristic **reddish-brown colour.** However, laterite soils are also typically **deficient in organic matter and humus content** due to the leaching process that removes these components.

Statement III is incorrect: The black soils are generally clayey, deep and impermeable. They swell and become sticky when wet and shrink when dried. So, during the dry season, these soil develop wide cracks. Thus, there occurs a kind of 'self ploughing'.

Thus, Black soils are associated with self-ploughing and not Laterite soils.

234. Solution: (a)

Exp) Option a is the correct answer.

Humus is the dark, organic matter in soil that results from the decomposition of plant and animal remains. It's a complex, stable substance that breaks down slowly, providing long-term benefits to the soil.

Option 1 is incorrect: Alluvial soils are formed by the deposition of sediments carried by rivers. Their composition varies greatly depending on the source of the sediments and the region. While alluvial soils are generally fertile due to their mineral content.**Alluvial soils have low humus content.**

Riverine alluvial soils may have moderate humus, especially in areas with dense vegetation, **but they are not typically known for high humus content.**

Option 2 is incorrect: They are generally **less fertile than alluvial soils and have a low humus content.** The hot climate in which they are often found contributes to faster organic matter decomposition.Red soils get their color from iron oxide.

Option 3 is correct: Mountain soils are found in mountainous regions and are significantly influenced by altitude and vegetation. In forested mountain areas, there is a substantial **accumulation of organic matter from decaying leaves, branches, and other plant debris.** This leads to a **higher humus content compared to other soil types**. Therefore, mountain soils are the most likely to have high humus.

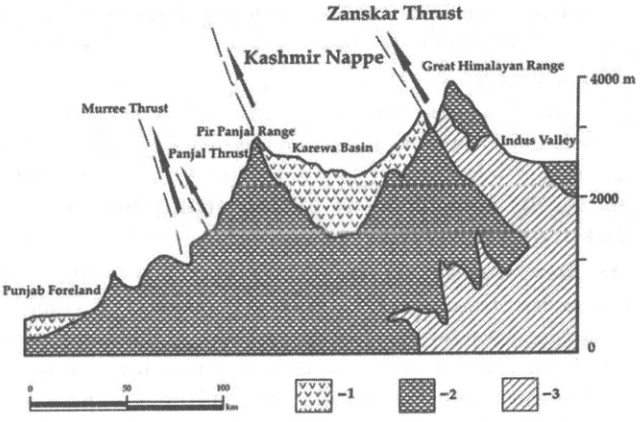
Option 4 is incorrect: Arid soils are found in dry regions with sparse vegetation. **Due to the lack of sufficient plant growth and rapid decomposition of organic matter in hot and dry conditions, these soils generally have very low humus content.**

235. Solution: (a)

Exp) Option a is the correct answer.

Option a is correct: Karewas are lacustrine deposits (sedimentary rock formations that accumulate at the bottom of lakes) **in the Valley of Kashmir and in Bhadarwah Valley** of the Jammu. Karewas are 13,000-18,000 metre-thick **deposits of alluvial soil and sediments like sandstone and mudstone.** These deposits are very important for the agriculture sector in Kashmir Valley. They are considered to be **ideal for cultivation of saffron, almonds, apples and several other cash crops.**

The Pir Panjal range's uplift blocked drainage, forming a vast lake in the Kashmir Valley. Rivers deposited sediments like clay and silt into this lake over centuries. Eventually, the lake drained through the Baramulla gorge, leaving behind the layered sediment deposits called Karewas.



Option b is incorrect: The Bhabar is a narrow, porous, northern most stretch of Indo-Gangetic plain. It is about 8-16 km wide running in east-west direction along the foothills (alluvial fans) of the Shiwaliks.

Option c is incorrect: Dooars are the alluvial floodplains in northeastern India that lie between foothills of the Himalayas and Brahmaputra plain.

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Option d is incorrect: Duns are longitudinal valleys located between the Lesser Himalayas and the Shiwaliks. They are important for agriculture and human settlements in the Himalayan region.

236. Solution: (a)

Exp) Option a is the correct answer.

Statement I is correct: In areas where irrigation is used excessively, especially in regions with poor drainage, waterlogging occurs. Over time, the evaporated water leaves behind salts, leading to soil salinization. This process depletes soil fertility and reduces agricultural productivity.

Statement II is correct and explains statement I: In dry climatic conditions, excessive irrigation promotes capillary action. As water from lower layers moves upward through capillary action, it carries dissolved salts to the surface. Once the water evaporates, the salts accumulate on the soil surface, making it saline and less fertile for crop growth.

237. Solution: (a)

Exp) Option a is the correct answer.

The Black soils are generally clayey, deep and impermeable. Black soil covers most of the Deccan Plateau which includes parts of Maharashtra, Madhya Pradesh, Gujarat, Andhra Pradesh and some parts of Tamil Nadu.

Statement 1 is correct. Black Soil swell and become sticky when wet and shrink when dried. So, during the dry season, these soils develop wide cracks. Thus, there occurs a kind of 'self-ploughing'. Because of this character of slow absorption and loss of moisture, the black soil retains the moisture for a very long time, which helps the crops, especially, the rain fed ones, to sustain even during the dry season.

Statement 2 is incorrect. Chemically, the black soils are rich in lime, iron, magnesia and alumina. They also contain potash. But they lack in **phosphorous, nitrogen and organic matter**. The colour of the soil ranges from deep black to grey.

Statement 3 is correct. In all regur soils in general, and in those derived from ferromagnesian schists in particular, there is a layer rich in kankar nodules formed by segregation of calcium carbonate at lower depths. **As a general rule, black soils of uplands are of low fertility but they are darker, deeper and richer in the valleys.**

Statement 4 is correct. Because of their high fertility and retentivity of moisture, the black soils are widely used for producing several important crops. Some of the major crops grown on the black soils are cotton, wheat, jowar, linseed, Virginia tobacco, castor, sunflower and millets. **Rice and sugarcane** are equally important where irrigation facilities are available. Large varieties of vegetables and fruits are also successfully grown on the black soils.

238. Solution: (c)

Exp) Option c is the correct answer.

Mountain Soils are mainly heterogeneous soils found mostly on the hill slopes covered by forests. The formation of these soils is mainly governed by the characteristic deposition of organic matter derived from forests and their character changes with parent rocks, ground-configuration and climate.

Statement 1 is correct. The mountain soils are complex and extremely varied. The soils vary from deep alluvium in the river basins and lower slopes to highly immature residual gravelly on higher altitudes. Because of complex topographic, geologic, vegetation and climatic conditions, no large areas of homogenous soil groups are found.**These soils are heterogeneous in nature and their character changes with parent rocks, ground-configuration and climate. Consequently, they differ greatly even if they occur in close proximity to one another.**

Statement 2 is correct. These soils are very **rich in humus but are deficient in potash, phosphorus and lime.** Therefore, they require good deal of fertilizers for high yields.

239. Solution: (b)

Exp) Option b is the correct answer.

Land degradation refers to the deterioration or loss of the productive capacity of the soils for present and future.

Statement 1 is correct. Recently, a document published by ISRO (Indian Space Research Organization) named Desertification and Land Degradation Atlas shows that Land Degradation and Desertification has increased significantly in recent years. India **witnessed an increase in the level of desertification** in 28 of 31 states and Union territories between 2011-13 and 2018-19, a closer look at data in the atlas showed.

Around 23.79% of the area undergoing desertification / land degradation with respect to TGA of the country was contributed by Rajasthan, Maharashtra, Gujarat, Karnataka, Ladakh, Jharkhand, Odisha, Madhya Pradesh and Telangana.

Statement 2 is incorrect. Vegetation degradation is defined as, "the temporary or permanent reduction in the density, structure, species composition or productivity of vegetation cover". It is found to be responsible for 9.15% of desertification in the country.

Statement 3 is correct. Badlands are a type of dry terrain where softer sedimentary rocks and clay-rich soils have been extensively eroded. It results in Badland Topography which itself is an initial stage of desertification. In 2011-13, water erosion was responsible for 10.98% of desertification in the country.

Statement 4 is correct. Wind erosion was found to be responsible for 5.46% of the desertification in India. Sand encroachment by wind reduces fertility of the soil making the land susceptible to desertification.

GENERAL GEOGRAPHY

ECONOMIC AND HUMAN GEOGRAPHY (INDIA AND THE WORLD)

6.1. Natural and Mineral Resources and Their Distribution around the World

1. It is the most abundant mineral group in the Earth's crust accounting for almost half of it. It is a group of aluminosilicate minerals that contain calcium, sodium, or potassium. It is used widely in the glass and ceramics industries. It also accounts for 60 percent of the exposed rocks, as well as soils, clays, and other unconsolidated sediments.

The above paragraph best describes which one of the following minerals?

(a) Quartz
(b) Pyroxene
(c) Calcite
(d) Feldspar

2. With reference to the land resources of India, consider the following statements:

1. About 30% of India's surface area is covered by hills and mountains.
2. India has an estimate of about 25% as a wasteland.
3. The highest incidence of wastelands is recorded in Rajasthan.

Which of the statements given above is/are correct?

(a) 2 and 3 only
(b) 1 only
(c) 1 and 3 only
(d) 1, 2 and 3

3. Read the following Paragraph:

'This country holds the largest oil reserves in the world. The majority of this oil is within the Orinoco Belt, which is at the southern end of the eastern Orinoco River Basin in the country. This belt has currently the largest deposit of petroleum in the world with estimates placing the capacity at more than 200 billion barrels.'

Which country is described in the above paragraph?

(a) Saudi Arabia
(b) Venezuala
(c) Canada
(d) United States of America

4. Consider the following statements regarding distribution of coal in India:

1. Gondwana coal makes up more than 90 percent of both coal reserves and coal production in India.
2. There are no tertiary coal reserves in India.
3. Jharia is the largest coal field in India.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

5. Consider the following natural resource regions:

1. Troll field
2. Groningen
3. Hassi R'Mel

The above regions are famous for which of the following natural resources?

(a) Coal
(b) Manganese
(c) Natural Gas
(d) Diamond

6. The Falkenmark Indicator is used to measure which of the following?

(a) It gives relation between economic poverty and water poverty
(b) It measures water scarcity as the amount of renewable freshwater that is available per person per year.
(c) It suggests policies that are needed to improve water management in a region.
(d) It shows the relation between Soil PH and water quality.

7. Consider the following statements related to Wind energy:

1. Production of wind energy releases less Carbon dioxide than solar energy.
2. India stands 4th globally in the total Wind power installed capacity.
3. In India, Tamil Nadu has the highest installed capacity of wind energy.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

8. Consider the following statements regarding Canal Irrigation in India:

1. It accounts for more than 20% of the total irrigation in the country.
2. Canal irrigation is mostly found in plain areas.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

9. Consider the following pairs of minerals and their largest producing state in India (as of 2020-21):

Minerals	Largest Producer
1. Iron Ore	Karnataka
2. Bauxite	Odisha
3. Manganese	Madhya Pradesh

Which of the above given pairs are correctly matched?

(a) 1 and 3 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

10. Arrange the following types of coal in India in an ascending order based on the carbon content in them:

1. Lignite
2. Peat
3. Anthracite
4. Bituminous

Which one of the following options correctly describes the order?

(a) 1-2-3-4
(b) 2-1-3-4
(c) 1-2-4-3
(d) 2-1-4-3

11. Often in the news, we come across terms like 'sweet crude oil' and 'sour crude oil'. In this context, which of the following statements are correct?

1. Brent crude oil is the example of sweet crude oil while Dubai crude oil is the example of sour crude oil.
2. The sweetness or sourness of the crude depends mainly on the amount of hydrogen present in the crude oil.
3. Sweet crude oil is found in the North Sea of Europe whereas sour crude oil is majorly found in Gulf of Mexico.
4. Sour crude oil is easier to refine and safer to extract than sweet crude oil.

Select the correct answer using the code given below:

(a) 1, 2 and 3 only
(b) 2 and 4 only
(c) 1 and 3 only
(d) 1, 2, 3 and 4

12. With reference to Polymetallic Nodules, consider the following statements:

1. They are found in all the oceans of the world.
2. Copper constitutes the largest component of polymetallic nodules.
3. The Indian Ministry of Earth Sciences is implementing a Polymetallic Nodules programme.

Which of the statements given above is/are correct?

(a) 1 and 3 only
(b) 1 only
(c) 2 and 3 only
(d) 1, 2 and 3

13. Consider the following statements regarding the Manganese mineral:

1. Karnataka has the largest share of Manganese deposits in India.
2. Manganese is a critical component of lithium-ion batteries, which are used in electric vehicles.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

14. With reference to various National waterways and their location in India, consider the following pairs:

National Waterways	Location
1. National Waterways 1	Ganga-Bhagirathi-Hooghly rivers
2. National Waterways 2	Brahmaputra river

3. National Waterways 3	Mahanadi-Brahmani rivers
4. National Waterways 4	Krishna-Godavari rivers

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

15. Consider the following statements:
1. Increase in Uranium concentration in the groundwater.
2. Increased chances of Land Subsidence.
3. Increase in Sea Level.
4. Increase in fluoride concentration in groundwater.

How many of the above can be the effects of over-exploitation of groundwater?
(a) Only one
(b) Only two
(c) Only three
(d) All four

16. With reference to the distribution of minerals across the world, consider the following pairs:

Regions	Rich in Minerals of
1. Ruhr	Coal
2. Boke	Lithium
3. Donbass	Bauxite
4. Antofagasta	Copper

How many pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

17. With reference to the iron ore reserves in India, consider the following statements:
1. Almost entire production of iron in India comes from the Magnetite ore.
2. More than one half of the total magnetite ore reserves are located in Odisha.
3. Noamundi mines are the major iron ore mines located in Jharkhand.

Which of the above given statements is/are correct?
(a) 1 and 3 only
(b) 2 only
(c) 3 only
(d) None of the above

18. Namchik – Namphuk (Arunachal Pradesh) and Kalakot (Jammu and Kashmir) are famous for the extraction of which of the following?
(a) Oil shale
(b) Petroleum
(c) Natural Gas
(d) Tertiary Coal

19. With reference to the rare earth elements, consider the following statements:
1. India has the world's largest reserves of rare earth elements.
2. All rare earth elements are metals.
3. Rare earth elements can be used as polishing compounds.

Which of the above given statements is/are correct?
(a) 1 and 3 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

20. Consider the following statements regarding land use pattern in India between the period 1950 to 2022:
1. The Net Sown Area has increased by more than 50 per cent in the given period.
2. The Culturable Wasteland have experienced a considerable increase in area over the specified period.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

21. Consider the following statements with reference to distribution of minerals resources in India:
1. Most of the metallic minerals in India occur in the peninsular plateau region in the old crystalline rocks.
2. Most of the coal reserves of India occur in the valleys of Narmada.
3. Petroleum reserves are located in the sedimentary basins of Assam, Gujarat and Mumbai High.

Which of the above given statements is/are correct?

(a) 1 and 3 only
(b) 1 only
(c) 3 only
(d) 2 and 3 only

22. Consider the following pairs:

Land Use Categories	Meaning/Feature
1. Gross cropped area	Total area of the land that was sown only once in a particular year.
2. Culturable Wasteland	Cultivable land that remains uncultivated for a period of one year or less.
3. Current Fallow	Arable land that remains uncultivated for a period exceeding one year but less than five years.

How many of the above pairs are **incorrectly** matched?
(a) Only one
(b) Only two
(c) All three
(d) None

23. With reference to the water utilization patterns in India, consider the following statements:
1. India is the world's second largest ground water user in the world after China.
2. The agriculture sector accounts for more than 70 per cent of total water usage in India.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

24. With reference to 'coal reserves in India', consider the following statements:
1. Majority of the coal deposits in India is of bituminous type.
2. Coal reserves can be found in rock sequences of Gondwana and Tertiary deposits.
3. Deposits of Anthracite coal can be found in Jammu and Kashmir.

Which of the above given statements are correct?
(a) 1 and 3 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1 and 2 only

25. Consider the following pairs:

Minerals	Industrial Application
1. Quartz	Used in electronic circuits
2. Olivine	Used in steel manufacturing.
3. Feldspar	Used in glassmaking industry.

How many of the above pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

26. Which of the following countries is the largest producer of gallium and germanium in the world?
(a) India
(b) United States
(c) China
(d) Australia

27. With reference to the distribution of lithium reserves around the world, consider the following statements:
1. Australia is the world's largest producer of lithium.
2. The lithium triangle spanning Bolivia, Chile and Argentina have more than half of the world's total identified lithium reserves.
3. Currently there is no presence of Lithium reserves in India.

Which of the statement/s given above is/are correct?
(a) 1 and 3 only
(b) 2 only
(c) 1 and 2 only
(d) 2 and 3 only

28. With reference to the iron ore reserves in India, consider the following statements:
1. Almost entire production of iron in India comes from the Haematite ore because of absence of Magnetite iron ore reserves in the country.
2. Nearly one third of the total hematite resources are located in Odisha.
3. Noamundi mines are the major iron ore mines located in Odisha.

Which of the statements given above is/are correct?

(a) 2 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1 and 3 only

29. With reference to the Polymetallic nodules, consider the following statements:

1. Cobalt and Copper form the largest components of polymetallic nodules.
2. The licence to extract it from the international sea is given by the International Maritime Organisation.
3. The Deep Ocean mission of India aims to send humans deep into the ocean to mine polymetallic nodules.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 2 and 3 only

30. With reference to mining in India, consider the following mines:

1. Malanjkhand Mine
2. Banwas Mine
3. Kendadih Mine

Which of the following minerals are associated with above given mines?

(a) Mica
(b) Copper
(c) Lead
(d) Aluminium

31. With reference to the lead and zinc, consider the following statements:

1. The lead and zinc can never occur together in an ore.
2. India lacks self-sufficiency in zinc production but has excess production of lead.
3. In India, Rajasthan is endowed with the largest amount of lead and zinc reserves.

Which of the statements given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 3 only
(d) 2 and 3 only

32. With reference to the Tertiary and Gondwana coal, consider the following statements:

1. The Gondwana coals are found in the sedimentary rocks while the tertiary coals are found in the igneous rocks.
2. Tertiary coal has higher sulphur content than the Gondwana coal.
3. Singrauli coal mines is one of the major producers of Tertiary coal in India.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) 2 and 3 only
(d) 1 and 3 only

33. Consider the following statements regarding Natural Gas in India:

1. In India, Natural Gas is found mainly in the Northern states of Punjab and Haryana.
2. The fertilizer sector is the largest consumer of Natural Gas in India.
3. Limited private sector investment is the major constraint in the production of Natural gas in India.

Which of the statements given above is/are correct?

(a) 1 and 3 only
(b) 3 only
(c) 2 and 3 only
(d) 1 and 2 only

34. Consider the following pairs:

Important Minerals	Largest producing country in the world
1. Uranium	Australia
2. Gold	Switzerland
3. Aluminum	China
4. Copper	Argentina

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

35. With reference to depleting water resources in India, consider the following statements:

Statement I: Indian agriculture accounts for more than two-third of the total water utilization in India.

Statement II: India has the largest cropland in the world.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.

(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

36. India is heavily dependent on other countries for its supply of critical minerals. In this context, consider the following pairs:

Critical Minerals	Major Source of Imports for India
1. Vanadium	Kuwait
2. Cobalt	China
3. Nickle	Sweden

How many of the above pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

37. 'Limonite' and 'Siderite' are the ores of which of the following metals?
(a) Iron
(b) Copper
(c) Aluminum
(d) Gold

38. Consider the following statements with reference to Mica:
1. Mica can be found in all three major rocks varieties- igneous, sedimentary and metamorphic.
2. It is an important mineral used in the electric and electronic industry as insulating material.
3. Kodarma district of Jharkhand is worldwide famous for mica.
4. India is the largest producer of mica in the world.

Which of the statements given above are correct?
(a) 1, 2 and 3
(b) 2, 3 and 4
(c) 1, 3 and 4
(d) 1, 2 and 4

39. Consider the following:
1. Kerala
2. Odisha
3. Assam
4. Tamil Nadu
5. Andhra Pradesh

How many of the above states have significant reserves of Monazite mineral?
(a) Only two
(b) Only three
(c) Only four
(d) All five

40. Consider the following pairs regarding the type of biofuels and the raw material used for their production:

Generation of Biofuels	Primary Raw Material
1. First-generation Biofuels	Edible materials like wheat and sugarcane
2. Second-generation Biofuels	Non-edible materials such as rice husk
3. Third-generation Biofuels	Genetically engineered crops
4. Fourth-generation Biofuels	Animal waste like cow dung

Which of the above given pairs are correctly matched?
(a) 1 and 2
(b) 3 and 4
(c) 1 and 4
(d) 2 and 3

41. Consider the following minerals:
1. Felspar
2. Mica
3. Dolomite
4. Gypsum

How many of the above minerals are classified as Minor Minerals in India?
(a) Only one
(b) Only two
(c) Only three
(d) All four

42. Consider the following pairs:

Mineral ore	State with Largest Reserves
1. Copper ore	Rajasthan
2. Lead ore	Gujarat
3. Tungsten ore	Karnataka
4. Silver ore	Andhra Pradesh

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

43. Consider the following statements:
1. It is the primary mineral used in the production of stainless steel.
2. South Africa is the largest producer of this mineral.
3. In India, more than 90% of its resources are located in Odisha and the bulk of it is confined to Sukinda valley.

Identify the mineral based on the information provided above?
(a) Wolfram
(b) Chromite
(c) Zinc Concentrate
(d) Pyrolusite

44. Consider the following statements regarding Phospho-gypsum:
1. It is a byproduct of fertilizer production.
2. It consist of radioactive elements such as uranium and thorium.
3. Its usage has recently been banned in road construction by the Government of India.

Which of the statements given above are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2, and 3

45. Consider the following pairs:

Ore	Primary Mineral extracted
1. Galena	Lead
2. Chalcopyrite	Zinc
3. Cinnabar	Mercury

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

46. Lac is a resinous substance that is obtained from insects. In this context, consider the following statements:
1. Lac is a natural resin produced by the insect Laccifer Lacca.
2. India is the largest producer of lac in the world.
3. Jharkhand is the largest lac producing state in India.
4. It can be used in making electrical insulation materials.

Which of the above given statements are correct?
(a) 1, 2 and 3 only
(b) 2, 3 and 4 only
(c) 1, 3 and 4 only
(d) 1, 2, 3 and 4

47. Consider the following:
1. Magnesite
2. Kyanite
3. Sillimanite

How many of the above minerals are metallic minerals?
(a) Only one
(b) Only two
(c) All three
(d) None

48. Consider the following statements:

Statement-I: In India, only Central Public Sector Enterprises can mine Beryllium and Titanium bearing minerals.

Statement-II: As per the Mines and Minerals (Development and Regulation) Act, 1957, only Central Public Sector Enterprises can mine minerals identified as atomic minerals.

Which one of the following is correct in respect of the above statements?
(a) Both Statement-I and Statement-II are correct and Statement-II explains Statement-I.
(b) Both Statement-I and Statement-II are correct and Statement-II does not explain Statement-I.
(c) Statement-I is correct but Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

49. Consider the following statements:
1. Tamil Nadu has the largest lignite reserves among the Indian states.
2. Gevra coal mine, the largest coal mine in India, is located in the state of Chattisgarh.
3. Among the Indian states, Madhya Pradesh has the largest coal reserve.

Which of the above statements is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 1, 2 and 3
(d) 2 only

50. To ensure the country's energy security, the Indian government set up Strategic Petroleum Reserves at various locations. In this context, consider the following places:

1. Visakhapatnam, Andhra Pradesh
2. Mangaluru, Karnataka
3. Kochi, Kerala

In how many of the above places the Strategic Petroleum Reserves are located?

(a) Only one
(b) Only two
(c) All three
(d) None

51. With reference to groundwater usage in India, consider the following statements:

1. India accounts for nearly 25% of the total groundwater extraction in the world.
2. In India, the agriculture sector is the largest consumer of groundwater resources, accounting for more than 85% of the total annual groundwater extraction.
3. According to the Dynamic Ground Water Resource Assessment Report-2024, the total annual groundwater extraction in India has almost doubled in 2024 compared to 2017.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 1 and 3 only
(d) 3 only

52. Kolihan and Surda are well known mining sites for which of the following?

(a) Gold mining
(b) Copper mining
(c) Coal mining
(d) Zinc mining

53. Consider the following statements regarding Bauxite:

1. India is the largest producer of Bauxite in the world after Australia.
2. Gallium, a rare metal, is extracted from bauxite during the Bayer process.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

54. With reference to Indian geography, consider the following pairs:

Mines	Well known for the mining of
1. Singrauli	Coal
2. Ratnagiri	Copper
3. Malanjkhand	Bauxite

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

55. Consider the following statements:

Statement-I: India is one of the leading producers of iron ore in Asia.

Statement-II: India has the largest reserves of iron ore in Asia.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I.
(b) Both Statement-I and Statement-II are correct but Statement-II is not the correct explanation for Statement-I.
(c) Statement-I is correct Statement-II is incorrect.
(d) Statement-I is incorrect but Statement-II is correct.

56. Consider the following statements about coal in India:

1. India has the second largest coal reserves in the world.
2. Anthracite coal constitutes more than 60% of India's total coal reserves.
3. The Damodar Valley is one of the richest coal-bearing regions in India.

Which of the statements given above is/are correct?

(a) 2 only
(b) 3 only
(c) 2 and 3 only
(d) 1 and 3 only

57. Naharkatiya and Kosamba regions in India are well known for:

(a) Diamond reserves
(b) Oil reserves
(c) Iron ore mining
(d) Copper deposits

58. Pyrolusite and Braunite are important ores of:
(a) Zinc
(b) Manganese
(c) Nickel
(d) Lead

59. With reference to Dharwar rock system in India, consider the following statements:
1. It is the oldest metamorphosed sedimentary rock system of India.
2. It is found only in the peninsular region of India.
3. It is rich in minerals, including gold, lead, and mica.

Which of the statements given above are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

60. In the context of the methods of mining, consider the following statements:
1. Underground mining provides more occupational safety than Open-cast mining.
2. Open-cast mining is economically cheaper than underground mining.
3. Underground mining generally has less impact on the environment than open cast mining.

Which of the above given statements is/are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 only
(d) 1, 2 and 3

61. Athabasca Basin region of Canada, Chu-Sarysu basin in Kazakhstan and McArthur River basin in Canada are well known for their:
(a) uranium deposits
(b) automobile industries
(c) Mica deposits
(d) Food processing industries

62. Which of the following statement is correct regarding groundwater utilization in India?
(a) All the users of the groundwater have to obtain a No Objection Certificate from Central Ground Water Board (CGWB) at regular interval.
(b) Every owner of land can collect and dispose water under the land within his own limits.
(c) India is the largest exporter of ground water in the world.
(d) India has more usable groundwater than surface water.

63. With reference to mines and their major minerals, which of the following pairs are correctly matched?

Mines	Minerals they are famous for
1. Badampahar	Iron
2. Lohardaga	Bauxite
3. Jhunjhunu	Copper

Select the correct answer using the code given below:
(a) 1 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) None of these

64. Consider the following statements with reference to Coal in India:
1. More than 90 percent of India's total coal reserves are from Gondwana times.
2. More than three fourth of the coal deposits in India is of bituminous type.
3. Bituminous has a high level of moisture content resulting in very low calorific value.
4. Anthracite coal is found in Jammu and Kashmir in some quantity.

Which of the above statements is/are correct in the above context?
(a) 1, 2 and 4 only
(b) 2, 3 and 4 only
(c) 1, 2, 3 and 4
(d) 1 and 3 only

65. Which of the following statements is correct about Manganese in India?
(a) It is found in Dharwar system of rocks.
(b) Jharkhand is the largest producer of manganese.
(c) The most important manganese ore is Limonite.
(d) It is found as a free element in nature.

66. Consider the following pairs:

Mineral	Mines in India
1. Gold	Hutti and Ramagiri
2. Silver	Sindeshar Khurd and Zawwar
3. Diamond	Panna

Which of the above pairs is/are correctly matched?

(a) 1 and 2 only
(b) 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

67. Consider the following statements with reference to rare earth elements in India:

1. India imports rare earth metals due to lack of sufficient reserves in India.
2. Matsya 6000 is a deep-sea vehicle to be utilized for deep sea exploration of rare minerals.
3. Rare earth elements are found only in the western coast of India.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 2 and 3 only
(d) 3 only

68. Consider the following statements regarding Uranium and Thorium deposits in India:

1. World's largest thorium reserves are found in India.
2. Most of the world's uranium reserves are found in Kazakhstan.
3. Both Uranium and Thorium are fissile substance and can be used directly in nuclear reactors.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

69. With reference to Coal bed methane (CBM), consider the following statements:

1. It is formed during the natural conversion of plant material into coal.
2. It can be converted into other types of hydrocarbons like diesel and gasoline.
3. It is a form of natural gas which does not release Carbon dioxide during combustion.
4. The Gondwana sediments host the bulk of India's current CBM producing blocks.

Which of the above statements are correct?

(a) 1 and 3 only
(b) 2, 3 and 4 only
(c) 1, 2 and 4 only
(d) 1, 2, 3 and 4

70. Consider the following pairs:

Mineral/Rock	Mining Method
1. Coal	Open cast Mining
2. Platinum	Shaft Mining
3. Marble	Quarrying

Which of the pairs given above is/are correctly matched?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

71. With reference to the difference between Opencast mining and Underground mining, consider the following statements:

1. Underground mining is usually more expensive than opencast mining.
2. Underground mining usually has a higher output than opencast mining.
3. Once mining activity ceases, unlike open cast mining, underground mining does not require land reclamation efforts.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

72. Consider the following statements regarding India's Net Sown Area:

1. While calculating net sown area, an area would be counted double if it is being sown twice in the year.
2. Compared to the year 1990-1991, the Net Sown Area in India in 2022-23 has increased.

Which of the statements given is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

6.2. Industry and Location Factors

73. Consider the following pairs regarding the Industrial regions of the world and the country they are associated with:

Industrial Regions	Country
1. Lancashire Region	United States of America
2. Southern Appalachian	Switzerland
3. Keihin Region	Germany

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

74. Which of the following are the major regions of Iron and steel industries in world?

1. Osaka-Kobe region
2. Ruhr region
3. Bokaro – Rourkela region
4. Urengoy region

Select the correct answer using the code given below:

(a) 1 only
(b) 2 and 3 only
(c) 1, 2 and 3 only
(d) 1, 2, 3 and 4

75. Industries using weight-losing raw materials are usually located near the regions where raw materials are located. In this context which of the following industries are based on weight losing raw materials?

1. Sugar mills
2. Pulp industry
3. Iron and steel industry
4. Copper smelting industries
5. Cotton industry

Select the correct answer using the code given below:

(a) 1, 3 and 4 only
(b) 1, 2, 3 and 4 only
(c) 2, 4 and 5 only
(d) 1, 2, 3, 4 and 5

76. Consider the following pairs of Nuclear Reactors and the state in which they are located:

Nuclear Reactors	State
1. Rawatbhata	Karnataka
2. Kaiga	Rajasthan
3. Kakrapar	Gujarat
4. Kalpakkam	Tamil Nadu

How many of the above given pairs are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

77. Consider the following statements with respect to the Fertilizer industry in India:

1. Natural gas availability plays a key role in deciding the location of nitrogen-based fertilizer industry.
2. Rock Phosphate, a key component of fertilizer industry, is largely imported.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

78. With reference to the major industrial regions in India, consider the following pairs:

Major Industrial regions of India	Factors responsible for its growth
1. Gurgaon-Delhi-Meerut Region	It's easy accessibility to minerals and power resources.
2. Bangalore-Chennai Industrial Region	Its location near coalfields.
3. Chotanagpur Region	Its location near iron ore sources.
4. Gujarat Industrial Region	Its location near cotton growing area

Which of the pairs given above are correctly matched?

(a) 1 and 3 only
(b) 1 and 4 only
(c) 2, 3 and 4 only
(d) 3 and 4 only

79. It refers to work related to the highest level of decision making and policy making. It involves work related to the administration. It focuses on the creation, re-arrangement and interpretation of new and existing ideas and the use and evaluation of new technologies.

Which one of the following terms best define the above activity?

(a) Secondary activity
(b) Quaternary activity
(c) Quinary activity
(d) Primary activity

80. With reference to the fertiliser industry in India, consider the following statements:

1. Currently, only Indian Farmers Fertiliser Cooperative Limited (IFFCO) produces the Government approved nano urea in India.
2. Many fertiliser industries in India are located near the oil refineries.
3. India meets more than two third of its urea demand through imports.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 3 only
(d) 1,2 and 3

81. Consider the following pairs:

Steel Plant	Location
1. Visvesvaraya Iron and Steel Plant	Madhya Pradesh
2. Rourkela Steel Plant	Odisha
3. Durgapur Steel Plant	West Bengal

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

82. Consider the following statements:

Statement-I: In hilly areas having difficult terrain, Narrow Gauge railway tracks are preferred over Standard Gauge.

Statement-II: Narrow Gauge tracks have a smaller radius of curvature than Standard Gauge tracks.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I
(c) Statement-1 is correct but Statement-II is incorrect
(d) Statement-l is incorrect but Statement-II is correct

83. Which of the following statements best explains the concept of 'Basic Industries'?

(a) Industries that produce day to day consumer goods which are non-durable in nature.
(b) Industries that produce and supply raw materials for other industries.
(c) Industries that offer vital services, such as transportation, essential for the operations of other sectors.
(d) Industries that relies heavily on manual labor with little to no degree of automation.

84. Consider the following statements regarding Footloose industries:

1. Compared to resource-based industries, the location of these industries is less affected by the factors of production.
2. Footloose industries generally have a low carbon footprint.
3. Computer chips industry is an example of the footloose industry.

Which of the above given statements is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1 and 2 only

85. With reference to Jute Industry in India, consider the following statements:

1. After Independence, most of the jute mills went to erstwhile East Pakistan.
2. All the jute produced in India currently comes from states of West Bengal and Assam.
3. The Jute industry is traditionally an export-oriented industry.

Which of the above given statements is/are correct?

(a) 3 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) None of the above

86. With reference to the Fertilizer Industry in India, consider the following statements:

1. Most of the urea fertilizer industries of India are located near oil refineries.
2. India meets more than two-third of its domestic demand for urea through imports.
3. At present, fertilizers are exempt from the regime of Goods and Services Tax.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1 and 3 only

87. With respect to major ports of India, Consider the following pairs:

Port	Well-known as
1. Jawaharlal Nehru Port	Largest container port in India.
2. Mumbai Port	Natural harbor and the largest port of the country
3. Kolkata Port	Only riverine Major Port of India

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

88. With reference to the mineral resources in India Ankeleshwar and Moran-Hugrijan are known for which of the following mineral resources?

(a) Petroleum
(b) Coal
(c) Iron
(d) Bauxite

89. With respect to the economic geography, consider the following pairs:

Place	Major economic activity
1. Detroit, USA	Automobile manufacturing
2. Orinoco basin, Venezuela	Oil reserves
3. Kryvyi Rih, Ukraine	Iron ore mining
4. Chuquicamata, Chile	Copper

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

90. Water is a crucial resource for industrial operations, and its consumption varies significantly across different sectors. In this context, which of the following industries is the highest consumer of water in India?

(a) Textiles
(b) Pulp and Paper
(c) Steel
(d) Thermal power plant

91. Consider the following Industries:

1. Diamond cutting
2. Semiconductor manufacturing
3. Pharmaceuticals
4. Cotton Textiles
5. Shipbuilding

How many of the above are generally classified as Footloose Industries?

(a) Only two
(b) Only three
(c) Only four
(d) All five

92. Consider the following:

1. Lower Transportation Costs
2. Higher speed efficiency
3. Reduced greenhouse gas emissions.
4. Less Land Requirement

How many of the above are the advantages of Inland Waterways over road transportation in India?

(a) Only one
(b) Only two
(c) Only three
(d) All four

93. Consider the following information regarding Indian ports:

Port	Associated state	Feature
1. Deenday-al Port	Gujarat	It was the highest cargo handling major port of the country in 2023-24.

2. Jawaharlal Nehru Port Trust	Maharashtra	Handles highest volume of country's containerized traffic among all the major ports
3. Kamarajar Port	Kerala	India's Largest Privately owned port.

In how many of the above rows is the given information correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

94. "It is the busiest in the world and otherwise, called the Big Trunk Route"

The above description is most suitably for:

(a) the North Atlantic Sea route
(b) the Mediterranean–Indian Ocean Sea Route
(c) the Cape of Good Hope Sea Route
(d) the North Pacific Sea Route

95. Which among the following are principal reasons behind the decline in share of railways in total freight transport in India?

1. Absence of last mile delivery
2. Non-competitive tariff structure
3. Low capability to generate operational surplus
4. No foreign direct investment (FDI) permitted in railway infrastructure sector

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 1, 2 and 3 only
(c) 3 and 4 only
(d) 1, 2, 3 and 4

96. Which of the following is/are the main reason(s) for the growth of fishing industry in Japan?

1. Shallow continental shelf along its coast.
2. Presence of Oyashio & Kuroshio Ocean currents
3. Around 80 % of the land is not suitable for agriculture

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

97. With reference to the major industrial regions around the world, consider the following pairs:

Major Industry	Country/Region
1. Iron and Steel	Germany
2. Textiles	India
3. Information Technology	California, USA

Which of the pairs given above is/are correctly matched?

(a) 1 and 2 only
(b) 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

98. Consider the following statements with reference to Fast-moving consumer goods (FMCG) sector in India:

1. Household and personal care is the major segment of FMCG in India.
2. The urban segment is the largest contributor to the overall revenue generated by the FMCG sector in India.
3. 100% FDI is allowed in multi-brand retail for FMCG sector.

Which of the above statements is/are correct in the above context?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) 1 and 3 only

99. Which of the following activities are included in quaternary sector of the economy?

1. Software developers
2. Government officials
3. Tax consultants
4. Lawyers
5. Academic researcher
6. Physicians

Select the correct answer using the code given below:

(a) 1, 2, 5 and 6 only
(b) 1, 3 and 5 only
(c) 2, 3, 4 and 5 only
(d) 1, 3, 5 and 6 only

100. Which of the following factors are responsible for setting up of petroleum refineries?

1. Access to labour supply
2. Near to crude oil producing areas
3. Access to large bodies of water
4. Climate of the region

Select the correct answer using the code given below:

(a) 1, 2 and 3 only
(b) 2 and 4 only
(c) 3 and 4 only
(d) 1, 2, 3 and 4

101. Which of the following is the most appropriate reason for India losing out to countries like Bangladesh and Vietnam in textiles sector?

(a) High tariffs faced by Indian textile exporters in foreign markets.
(b) No subsidy is provided to the Indian textile industries to increase employment.
(c) Indian domestic policy favors clothing based on man-made fibres.
(d) India's GSP (Generalised system of preferences) benefits were terminated by US.

102. Consider the following statements regarding Iron-steel industry in India:

1. The demand of iron ore for Indian Steel Industry is met from domestic supply while the demand of coking coal is met mainly through imports.
2. The production cost of steel is relatively lower than aluminium when used in automotive production.
3. India is the second largest producer of crude steel in world.

Which of the statements above is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

103. Which of the following factors are responsible for affecting the location of Cotton Textile industries?

1. Reliable and cheap local investment
2. Development of hydro-electricity
3. Good relations between industry and trade unions

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

6.3. Population

104. Consider the following statements regarding urbanisation in India with reference to Census 2011:

1. The decadal growth rate of urbanization has increased continuously since 1950.
2. Tamil Nadu is the most urbanized State in India.
3. None of the states or Union Territories in India has 100% urban population.

Which of the statements given above is/are correct?

(a) 1 and 3 only
(b) 3 only
(c) 2 and 3 only
(d) 1 only

105. This Rural Settlement is formed on the basis of forms and shapes, and it extends on both sides of a river where there is a bridge or a ferry.

Which of the following Rural settlement is mentioned above?

(a) Star-shaped settlement
(b) T-shaped village settlement
(c) Double village settlement
(d) Linear village settlement

106. Which of the following options best describes the term Sub-Urbanization?

It is a situation in which-

(a) a country's urban population is considerably larger than expected according to that country's level of economic development.
(b) large numbers of people move from urban areas into surrounding countryside or rural areas.
(c) increasing influence of urban way of life in rural areas leading to deterioration of rural culture.
(d) outward growth of urban areas engulfs surrounding villages and towns into a larger urban agglomeration.

107. Consider the following pairs with respect to the different types of settlements:

Type of settlement	Description
1. Clustered settlement	houses are closely built up
2. Semi clustered settlement	fragmentation of a large compact village
3. Hamleted settlement	A single isolated settlement in remote area

Which of the pairs given above are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

108. Consider the following pairs about various approaches related to human geography and their central ideas:

Approach	Central Idea
1. Environmental determinism	Environment determines the patterns of human culture and societal development.
2. Environmental Possibilism	Culture is defined by the decisions that humans make in response to the limitations posed by the environment.
3. Neo-determinism	Environment will have no impact on the development of human culture

How many of the above given pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

109. Which one of the following options correctly describes the term "Demographic Window of opportunity"?
(a) It is a method used to calculate population changes between two consecutive years in a given area.
(b) It is a hypothetical demographic situation, where literacy rate among the country's population reaches 100 percent.
(c) It is a demographic situation where the proportion of the working-age population is relatively high compared to the dependent population.
(d) It refers to a period, in a nation's demographic evolution, when the proportion of dependent population is higher than working age population.

110. Which among the following criteria are to be met for a settlement to be qualified as a 'Census Town'?
1. The population must be greater than 10000.
2. Population density has to be greater than 400 persons per sq. Km.
3. At least 75% of the male main working population should be employed in non-agricultural sectors.

Select the correct answer using the codes given below:
(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 2 only

111. Consider the following pairs of population trends and respective shape of pyramids:

Type of Pyramid	Population trends
1. Expansive pyramid	It represents situation of high fertility and high mortality in an area
2. Stationary pyramid	It indicates high mortality and very low life expectancy levels in an area
3. Constrictive pyramid	Exclusively associated with least developed countries

How many pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

112. Consider the following statements regarding the Technopolies:
1. It is a society with a concentration of technology-based businesses.
2. They have massive assembly structures, factories, and storage areas.
3. White Collar workers generally outnumber Blue-collar workers in the technopolies.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2, and 3

113. According to the 2011 census, the total literacy rate in the country is 74.04%. Also, the male literacy rate is 82.14% and the female literacy rate is 65.46%. In this context, a literate is one who is aged seven and above and who has the ability to:

(a) do basic arithmetic calculations.
(b) either read or write with understanding in any language.
(c) do basic arithmetic calculations and read any language.
(d) both read and write with understanding in any language.

114. Consider the following statements regarding the Population Density and the Population Growth:

1. The Population Density is a measure of the concentration of population in a geographic area.
2. Natural Growth of Population is analysed by assessing the crude birth and death rates.
3. Induced Growth of Population is assessed by inward and outward movement of people from a given area.

Which of the statements given above are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

115. Consider the following tribes and the geographical regions where they are predominantly located:

Tribes	Geographical region
1. Yanomami	Brazil
2. Maori	Ethiopia
3. Bindibu	South Africa
4. Zulus	Australia

Which of the pairs given above is/are correct?

(a) 1 only
(b) 1 and 4 only
(c) 2 and 4 only
(d) 1, 2 and 3 only

116. Arrange the following countries in increasing order of their Population Density.

1. India.
2. Singapore.
3. Bangladesh.
4. Maldives.

Which of the options given below is correct?

(a) 3-4-2-1
(b) 4-3-2-1
(c) 4-3-1-2
(d) 1-3-4-2

117. Consider the following statements regarding the International Organization for Migration (IOM):

1. It is an Intergovernmental organization working as a part of the United Nations System.
2. It was established as a result of large-scale displacement caused by the dissolution of the Soviet Union.
3. World Migration Report is an initiative of the International Organization for Migration.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

118. Which of the following actions is most closely associated with the Capability Approach to Human Development?

(a) Ensuring an increased salary for individuals to enhance their freedom.
(b) Ensuring increased government spending on education, health, and amenities to maximize individual freedom.
(c) Promoting well-being for all citizens through the provision of basic essentials such as Food, Water, Sanitation and Housing.
(d) Developing human capabilities in health, education, and access to resources to broaden individual freedom.

119. With reference to migration in India as per Census 2011, consider the following statements:

1. The rural-to-rural migration in India is higher than rural to urban migration.
2. Tamil Nadu receives the highest number of migrants in India.
3. The largest share of international migrants in India is from Nepal.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 1 and 2 only
(d) 1 and 3 only

120. With reference to the population dynamics in India, consider the following statements:

1. India never experienced negative decadal population growth since the year 1900.
2. Since the year 1980, the decadal population growth rate has been continuously increasing.
3. As per the National Family Health Survey-5, Bihar has the highest Total Fertility Rate among the Indian states.

Which of the above given statements is/are correct?

(a) 3 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) None of the above

121. Consider the following statements regarding the Sex Ratio at Birth in India:

1. According to National Family Health Survey-5, Haryana has the lowest sex ratio at birth among all the states in India.
2. As per National Family Health Survey-5, no State or UT in India has Sex Ratio at Birth greater than 1000.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

122. Consider the following states/Union Territories:

1. Bihar
2. Kerala
3. Odisha
4. Andaman and Nicobar
5. Arunachal Pradesh

How many of the above states/Union Territories have a population density less than the average Population Density of India according to the 2011 census?

(a) Only two
(b) Only three
(c) Only four
(d) All five

123. With reference to the migration data provided by the Census of 2011, consider the following statements:

1. Intra-state movement accounted for majority of total internal migration in India.
2. Majority of intra-state migration was due to work and employment reasons.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

124. In the context of the economy, the term "Quinary activities" refers to which of the following activities?

(a) Construction and development of renewable energy infrastructure to reduce carbon footprint.
(b) Companies engaging tax consultants and auditing firms to improve their tax compliance.
(c) Using information technology and communication services to improve customer satisfaction.
(d) High-level decision-making and managerial roles within an organization.

125. Which one of the following statements best describes the term "Transhumance"?

(a) The permanent migration of people because of push factors like political or economic instability.
(b) A shifting cultivation practice, where farmers move to different areas in search of fertile lands.
(c) The seasonal movement of people with their livestock between different grazing lands.
(d) Permanent migration of the people due to the severe climatic conditions.

126. In the context of the Indian economy, the Labour Force Participation Rate (LFPR) refers to:

(a) the section of the working age population who are engaged in employment.
(b) the share of employed individuals in the total population of the country.
(c) the section of the working-age population currently employed or seeking employment.
(d) the section of the total population who are currently employed or seeking employment.

127. Consider the following statement:

Statement -I: In the demographic history of India, the year 1921 is known as the demographic divide.

Statement-II: The first nationwide census of India was released in the year of 1921.

Which one of the following is correct in respect of the above statements?

(a) Both Statement-I and Statement-II are correct and Statement-II is the correct explanation for Statement-I
(b) Both Statement-I and Statement-II are correct and Statement-II is not the correct explanation for Statement-I
(c) Statement-I is correct but Statement-II is incorrect
(d) Statement-I is incorrect but Statement-II is correct

128. Which one of the following international organizations releases the 'International Migration Outlook' report?

(a) World Economic Forum
(b) World Bank
(c) United Nation Population Division
(d) Organization for Economic Co-operation and Development

129. Consider the following statements:

1. It looks at human beings as beneficiaries or targets of all development activities.
2. It states that the people are not participants in development but only passive recipients.
3. It argues for higher government expenditure on education, health, community resources and amenities.

Which one of the following approaches to human development is described in the above given statements?

(a) Basic Needs Approach
(b) Income Approach
(c) Welfare Approach
(d) Capability Approach

130. In the context of urban development process, which of the following statements best describes the term 'Gentrification'?

(a) The physical separation of different social groups within a city, often based on income, race, or ethnicity.
(b) The population shift from high density urban centres to lower density residential areas on the outskirts.
(c) The process of wealthy individuals moving into a lower-income neighbourhood, leading to economic and social changes.
(d) The process of building housing, businesses, and urban amenities near public transport to encourage its use and reduce car dependence.

131. As per 2011 census of India, arrange the following states in descending order (from largest to lowest) based on their respective populations:

1. Madhya Pradesh
2. Tamil Nadu
3. Karnataka
4. Maharashtra

Select the correct answer using the code given below:

(a) 4-1-3-2
(b) 4-1-2-3
(c) 1-4-2-3
(d) 1-4-3-2

132. Consider the following statements, with reference to Particularly vulnerable tribal groups (PVTGs) in India:

1. There are a total of 75 identified PVTGs in India.
2. To qualify for PVTG status, a tribal group must demonstrate historical habitation of forest areas and dependence on forest for livelihood needs.
3. Chhattisgarh has the highest number of PVTGs in India.

Which of the above given statements is/are correct?

(a) 1 only
(b) 2 and 3 only
(c) 2 only
(d) 1 and 3 only

133. Consider the following statements with reference to Caste census and Caste Surveys in India:

1. Caste Census can be conducted only by the Union government, whereas Caste Survey can be done by both Union and State Governments.
2. Since Independence few State governments have conducted socio-economic caste surveys for better policy making.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

134. With respect to urban development, which of the following best describes the term 'Conurbation'?

(a) Cities together with their suburbs with a population of more than 10 million people.
(b) A human settlement that is larger than a village but smaller than a city.
(c) A leading town, which has outstripped its local or regional rivals.
(d) A large area that resulted from the merging of originally separate towns or cities.

135. Which of the following information can be inferred from the population pyramid of a country?

1. Composition of the country's population in various age groups.
2. Sex composition of the country's population.
3. Literacy levels of the country's population.

Select the correct answer using the code given below.

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1,2 and 3

136. Consider the following:

1. Bihar
2. Meghalaya
3. Rajasthan
4. Madhya Pradesh

According to the National Family Health Survey-5 (NFHS 5), how many of the above states have Total Fertility Rate (TFR) above the replacement level (TFR of 2.1)?

(a) Only one
(b) Only two
(c) Only three
(d) All four

137. Consider the following pairs:

Terms	Description
1. Stunting	Low weight with respect to the height of a child
2. Wasting	Low height with respect to the age of a child
3. Infant Mortality Rate	Number of infant deaths in a year per 1,000 live births during the year.

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

138. With reference to Scheduled Tribes (STs) in India, consider the following statements:

As per census 2011,

1. Madhya Pradesh has the highest tribal population among the Indian states.
2. Mundas are the most populous tribe in India.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

139. Consider the following countries:

1. India
2. China
3. Bangladesh
4. Sri Lanka

What is the correct arrangement of the above countries in descending order of their median age?

(a) 2, 4, 3, 1
(b) 2, 4, 1, 3
(c) 1, 2, 4, 3
(d) 1, 3, 4, 2

140. Consider the following pairs:

Tribes	Primarily Associated Country
1. Bushmen	Namibia
2. Masai	Tanzania
3. Samburu	Kenya
4. Maori	New Zealand

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

141. Which of the following best defines the Gross Reproduction Rate?

(a) The average number of total children a woman is expected to give birth to during her entire reproductive span conforming to the age-specific fertility rates for a given year if there is no mortality.

(b) The average number of female children a woman is expected to give birth to during her entire reproductive span conforming to the age-specific fertility rates for a given year if there is no mortality.
(c) The average number of male children a woman is expected to give birth to during her entire reproductive span conforming to the age-specific fertility rates for a given year if there is no mortality.
(d) The average number of live births per 1,000 married women during her reproductive years.

142. In the context of human geography, the term Urban Sprawl best refers to the:
(a) rapid growth of slums in a city within a short period of time.
(b) unplanned expansion of cities into surrounding areas.
(c) rapid growth in the number of industries in a city.
(d) development of high-rise buildings in urban centers.

143. The gravity model of migration explains that migration between two urban centers would be:
(a) proportional to the product of their population and the distance between them.
(b) proportional to the square of the distance between them and inversely proportional to the product of their population.
(c) proportional to the product of their population and inversely proportional to the square of the distance between them.
(d) proportional to the product of their population and the square of the distance between them.

144. Consider the following pairs:

Tribes in News	States/Regions to which they primarily belong to:
1. Gaddi	Chhattisgarh
2. Mankidia	Himachal Pradesh
3. Jarawa	Andaman and Nicobar Islands
4. Reang	Tripura

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

145. With reference to the growth of population in India, consider the following statements:
Statement I: During the period of 1951-1981, the population of India grew at an average annual rate of more than 5 percent.
Statement II: Apart from increase in natural birth rates, there was a large influx of migrants from Tibet, Bangladesh and Nepal during the decades of 1951-1981.
Which one of the following is correct in respect of the statements given above?
(a) Both statement -I and statement -II are correct and statement -II is the correct explanation for statement -I.
(b) Both statement -I and statement -II are correct and statement -II is not the correct explanation for statement -I.
(c) Statement -I is correct but statement -II is incorrect.
(d) Statement -I is incorrect but statement -II is correct.

146. Consider the following family of languages in India:
1. Austric
2. Dravidian
3. Sino-Tibetan
4. Indo-European

Arrange the following language groups of India in increasing order according to their percentage of speakers:
(a) 1-2-3-4
(b) 3-1-4-2
(c) 1-3-4-2
(d) 3-1-2-4

147. Consider the following pairs regarding prominent tribal communities in India and the states in which they primarily reside:

Tribe	State
1. Gaddis	Himachal Pradesh
2. Lepchas	Mizoram
3. Mankidia	Karnataka
4. Chenchu	Jharkhand

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

148. Which one of the following statements best describes the concept of possibilism in human geography?

(a) Human beings are entirely controlled by their nature, without any possibilities for their cultural development .
(b) Human beings make use of the opportunities provided by nature for their cultural development.
(c) Human beings have absolute freedom to exploit nature without any constraints.
(d) Human endeavors and the forces of nature work mutually exclusively and have no impact on each other.

149. Consider the following states in India:

1. Uttar Pradesh
2. Bihar
3. Tamil Nadu
4. Kerala

With reference to the States mentioned above, what is the correct ascending order in terms of their population density as recorded by the 2011 Census?

(a) 4-3-2-1
(b) 3-1-4-2
(c) 3-4-1-2
(d) 4-3-1-2

150. Consider the following statements regarding the Census of India:

1. The first synchronous census in India was conducted in 1911.
2. The Ministry of Home Affairs is responsible for conducting the census in India.
3. Any citizen can access the complete census data without restrictions.

Which of the statements given above is/are correct?

(a) 1 and 2 only
(b) 2 only
(c) 3 only
(d) 2 and 3 only

151. "This theory explains the changes in population dynamics as a society progresses from rural agrarian and illiterate to urban industrial and literate. It describes how a population changes from high birth rates and high death rates to low birth rates and low death rates in various stages as the society develops."

The above given paragraph best describes which one of the following theories ?

(a) Malthusian Theory
(b) Population Explosion Theory
(c) Modernization Theory
(d) Demographic Transition Theory

152. Which of the following is the most appropriate description of the term 'Agricultural Density'?

(a) It is the ratio between the total population of a country and its net cultivated area.
(b) It is the ratio between the agricultural population of a country and the total area of that country.
(c) It is the standard measurement of the amount of agricultural production harvested per unit of land area.
(d) It is the ratio between the total agricultural population of a country and its net cultivable area.

153. Which one of the following statements is *not* correct with reference to the land use changes in India between 1950-51 to 2014-15?

(a) Land area under forests has registered an increase.
(b) Area under non-agricultural uses has decreased.
(c) Area under permanent pastures and grazing land has increased.
(d) Area under tree crops and groves has registered a decline.

154. With reference to the population growth in India, consider the following statements:

1. India has never seen a negative population growth rate in the decadal census since 1901.
2. The decadal population growth rate of the country has started slowing down after 1981, as compared to the previous census.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

155. With reference to urbanization in India and the world, which of the following statements is/are correct?

1. The growth rate of urban population in India is constantly increasing every year since independence.
2. There has been a decline in rural population in India in the last decade.

3. Among the world capital cities, Delhi has the largest population.

Select the correct answer using the code given below:

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1, 2 and 3
(d) None of the above

156. What do you understand by the term 'Warabandi system'?

(a) A land revenue system
(b) A rotational water allocation system
(c) A system to convert wasteland into cultivated land
(d) A system to collect Agricultural waste

157. Consider the following statements with reference to population of India:

1. There was a negative growth rate in India's population during 1951-1981.
2. The decades 1921-1951 are referred to as the period of steady population growth.
3. The decades 1911-1921 are referred to as the period of population explosion in India
4. A downward trend of crude birth rate is held responsible for declining population growth post 1981.

Which of the above statements is/are correct?

(a) 2 and 4 only
(b) 1 and 3 only
(c) 2, 3 and 4 only
(d) 1, 2, 3 and 4

158. Consider the following statements:

1. The New Education Policy (NEP) 2020 sets the target of 50% gross enrolment ratio (GER) in higher education by 2035.
2. The literacy rate for Muslim women in India is higher than women of Scheduled Tribes and Scheduled Caste.
3. As per Census 2011, literacy rate of Scheduled Tribes was more than that of Scheduled Caste population.

Which of the above statements is/are correct in the above context?

(a) 2 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

SOLUTIONS

6.1. Natural and Mineral Resources and Their Distribution around the World

1. Solution: (d)

Exp) Option d is the correct answer.

Feldspar is the most abundant mineral group in the Earth's crust. **Almost half of the earth's crust is composed of feldspar.** Feldspars can form under a wide range of temperature and pressure conditions. Silicon and Oxygen are common elements of all types of feldspar. It is a group of aluminosilicate minerals that contain calcium, sodium, or potassium. It is **used in ceramic and glass making.** Feldspar **accounts for an estimated 60% of exposed rocks,** as well as soils, clays, and other unconsolidated sediments, and are principal components in rock classification schemes. The minerals included in this group are the orthoclase, microcline and plagioclase feldspars.

Important Tips

Quartz is a hard, crystalline mineral **composed of silica (silicon dioxide).** Quartz is a common component of silica-rich igneous rocks, forming up to 25% of the volume of granites. Quartz is physically and chemically resistant to weathering. **Quartz makes up about 12 percent of the land surface and about 20 percent of the Earth's crust.**

Pyroxene refers to an aluminous clinoferrosilite mineral and is the name of a group of dark-colored rock-forming minerals found in igneous and metamorphic rocks throughout the world. They form under conditions of high temperature and/or high pressure. **About 11% of the earth's crust is made up of pyroxene.**

Calcite is a rock-forming mineral with a chemical formula of CaCO3. It is extremely common and found throughout the world in sedimentary, metamorphic, and igneous rocks. Some geologists consider it to be a "ubiquitous mineral" - one that is found everywhere. **Approximately 4% of the earth's crust is composed of calcite.** It is a primary component of shells, the human skeleton, and is often found in ore deposits alongside other valuable calcium-containing minerals.

2. Solution: (b)

Exp) Option b is the correct answer.

In India, Land resources includes 43% of plains, 30 % of mountains and 27% of plateaus.

Statement 1 is correct. The physical features in India are diverse and complex. There are mountains, hills, plateaus and plains which produce varied human response to the use of land resources. **About 30% of India's surface area is covered by hills and mountains.** These are either too steep or too cold for cultivation. About 25% of this land is topographically usable which is scattered across the country. Plateaus constitute 28% of the total surface area but only a quarter of this is fit for cultivation. The plains cover 43% of the total area and nearly 95% of it is suitable for cultivation.

Statement 2 is incorrect. The National Remote Sensing Agency has estimated 53 million hectares (16%) as wasteland in the country.

Statement 3 is incorrect. Among the states, the highest incidence of wastelands is recorded in **Jammu and Kashmir (60%) followed by Rajasthan (38%), Sikkim and Himachal Pradesh (37% each) and Gujarat (17%).** The Government of India constituted the National Wasteland Development Board in 1985 with a view to enhancing productivity of wastelands.

3. Solution: (b)

Exp) Option b is the correct answer.

With more than 300 billion barrels of proven oil reserves in 2021, **Venezuela** holds the title of the largest oil reserves in the world. The majority of this oil is within the Orinoco Belt, which is at the southern end of the eastern Orinoco River Basin in the country. This belt is currently the largest deposit of petroleum in the world with estimates placing the capacity at more than 200 billion barrels!

When it comes to **oil production**, Venezuela sits much lower among other world leaders. This is because unlike many other countries on this list, Venezuelan crude oil is very heavy and requires large investments in technology, manpower, and refineries to extract.

Moreover, while it used to be one of the largest exporters in the world, an oil crash in 2015, political unrest, and subsequent issues have limited Venezuela's potential.

4. Solution: (b)

Exp) Option b is the correct answer.

The coal bearing strata of India are geologically classified into two main categories, viz., Gondwana coal fields & Tertiary coal field.

Statement 1 is correct: Gondwana coal comprises about 98 percent of the total reserves and 99 percent of the production of coal in India. In this system there are 113 major coal fields found all over India. Gondwana coal is said to be about 250 million years old.

Statement 2 is incorrect: Tertiary Coals are found in the states of Assam, Meghalaya, Nagaland, Arunachal Pradesh, Himachal Pradesh, West Bengal, Rajasthan, Kerala and Jammu and Kashmir. Tamil Nadu and the Union Territory of Pondicherry also have Tertiary coal reserves.

Statement 3 is correct: Jharia is the largest coal field followed by Raniganj. Other important coal mining centres are Singrauli in Madhya Pradesh (part of Singrauli coal field lies in Uttar Pradesh), Korba in Chhattisgarh, Talcher and Rampur in Odisha, Chanda–Wardha, Kamptee and Bander in Maharashtra and Singareni in Telangana and Pandur in Andhra Pradesh.

5. Solution: (c)

Exp) Option c is the correct answer.

1. **Troll Fields – Troll is a natural gas and oil field** in the Norwegian sector of the North Sea, one of the biggest in the North Sea, holding 40% of Norway's gas. It also possesses significant quantities of oil.
2. **Groningen Gas field – It is a natural gas field in Groningen** province in the northeastern part of the Netherlands. It is the largest natural gas field in Europe. This region of Groningen in the Netherland has a gas field that began operations in 1963.
3. **Hassi R'Mel - In** North Africa, the central basin of Algeria is the location of the Hassi R'Mel gas and condensate field, discovered in 1956 in a large anticline. The Hassi R'Mel **Natural gas field** recovered 82.32% of its total recoverable reserves, with peak production in 1999.

6. Solution: (b)

Exp) Option b is the correct answer.

One of the most commonly used measures of water scarcity is the 'Falkenmark indicator' or 'water stress index'. This method defines water scarcity in terms of the total water resources that are available to the population of a region; measuring scarcity as the amount of renewable freshwater that is available for each person each year. If the amount of renewable water in a country is below 1,700 m3 per person per year, that country is said to be experiencing water stress; below 1,000 m3 it is said to be experiencing water scarcity; and below 500 m3, absolute water scarcity.

7. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct. The production of wind energy is **more efficient than production of solar energy**. Wind turbines **release less CO2** to the atmosphere compared to solar energy production. A wind turbine produces 4.64 grams of CO2/1kWh while the solar panel produces 70 grams of CO2/1kWh. Wind power consumes less energy and produces more energy compared to solar panels.

Statement 2 is correct. India stands **4th globally in Renewable Energy Installed Capacity** (including Large Hydro), **4th in Wind Power capacity** & 4th in Solar Power capacity (as per REN21 Renewables 2022 Global Status Report).

Statement 3 is correct. Tamil Nadu's installed wind power capacity stood at 9,867 megawatts (MW), the **highest among all states**. The key reason behind maximum installations happening in Tamil Nadu is the state having good wind sites because of its coastal vicinity resulting in higher installations.

8. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct. A canal is an artificial channel that is constructed to carry water to the fields to perform irrigation. It is one of the most important sources of water irrigation. It accounts for **around 25% of total irrigation** in the country.

Statement 2 is correct. Canal irrigation is possible in areas that are extensive like plains and are **drained by perennial rivers**, such as the northern plains, coastal plains, deltas and broad valleys of the Indian peninsula. The **plain areas of India are mostly canal irrigated**. States that follow canal irrigation system are Andhra Pradesh, Assam, Haryana, West Bengal, Punjab, Rajasthan, Bihar, Karnataka, Tamil Nadu and Uttar Pradesh.

9. Solution: (c)

Exp) Option c is the correct answer.

Pair 1 is incorrect: Odisha is the leading producer of iron ore accounting for 51.1% of total production followed by Chhattisgarh (18.0%), Karnataka (16.9%), Jharkhand (10.4%) and remaining (3.32%) production was reported from Andhra Pradesh, Madhya Pradesh, Maharashtra and Rajasthan

Pair 2 is correct: Odisha with 76. 3% contribution is the leading producer of bauxite followed by Gujarat (7.3%), Chhattisgarh (3.5%), Jharkhand (7.3%), Madhya Pradesh (3.1%), and Maharashtra (2.3%).

Pair 3 is correct: Madhya Pradesh is the largest producer of Manganese Ore contributing 34.3% in the total output of the country in 2020-21.

10. Solution: (d)

Exp) Option d is the correct answer.

Coal is one of the most important primary fossil fuels, a solid carbon-rich material that is usually brown or black and most often occurs in stratified sedimentary deposits. India is rich in ancient coal fields like Gondwana coalfields (250 million years old) and tertiary coalfields (15-60 million years old).

Coal is found in a variety of forms depending on the degrees of compression and the depth and time of burial.

1) **Option 2:** Peat has **less than 40 per cent carbon content.** It is in the first stage of transformation from wood to coal. It has low calorific value and burns like wood.
2) **Option 1:** Lignite is often brown in colour. It carries **40 to 55 per cent carbon content.** It is an intermediate stage which happens during the alteration of woody matter into coal. It has high moisture content, so it gives smoke when burnt. It is found in Rajasthan, Lakhimpur (Assam), and Tamil Nadu.
3) **Option 4:** Bituminous carries **60 to 80 per cent of carbon content** and a low level of moisture content. It is widely used and has high calorific value. It is found in Jharkhand, West Bengal, Odisha, Chhattisgarh and Madhya Pradesh.
4) **Option 3:** Anthracite is the best quality of coal which carries **80 to 95 per cent carbon content**. It ignites slowly with a blue flame. It has the highest calorific value. It is found in small quantities in Jammu and Kashmir.

Thus, the correct sequence of types of coal based on their carbon content is 2-1-4-3.

11. Solution: (c)

Exp) Option c is the correct answer.

Crude oil is a black liquid found in geological formations. It is a fossil fuel, which means it is formed from dead organisms that are buried under intense heat and pressure. But not all crudes are alike.

Statement 1 is correct: Brent crude oil is the example of sweet crude oil while Dubai crude oil is the example of sour crude oil.

Statement 2 is incorrect: Crude oil is defined as "sour" if its sulfur content exceeds 0.5%, or if it does not meet the required thresholds for hydrogen sulfide and carbon dioxide levels. Sweet crude, on the other hand, is defined by the New York Mercantile Exchange (NYMEX) as petroleum with sulfur levels below 0.42%. **Thus, sulfur content is the main criterion for defining crude sweet or sour.**

Statement 3 is correct: Major locations where sweet crude is found include the **Appalachian Basin in Eastern North America, Western Texas, the Bakken Formation of North Dakota and Saskatchewan, the North Sea of Europe, North Africa, Australia, and the Far East including Indonesia.**

Sour crude is more common in **the Gulf of Mexico, Mexico, South America, and Canada**. Crude produced by **OPEC Member Nations** also tends to be relatively sour, with an average sulfur content of 1.77%.

Statement 4 is incorrect: Sweet crude is easier to refine and safer to extract and transport than sour crude. Because sulfur is corrosive, light crude also causes less damage to refineries and thus results in lower maintenance costs over time. Due to all these factors, sweet crude commands up to a $15 dollar premium per barrel over sour.

12. Solution: (a)

Exp) Option a is the correct answer

Polymetallic nodules, also called **manganese nodules**, are rock concretions formed of **concentric layers of iron and manganese hydroxides** around a core.

Statement 1 is correct: Nodules have been found in all the oceans and even in lakes. However, nodules of **economic interest** are more localised. **Three areas** have been selected by industrial explorers: the centre of the **north central Pacific Ocean, the Peru Basin in the south-east Pacific Ocean and the centre of the north Indian Ocean.** Also, they can occur at any depth, but the **highest concentrations have been found between 4,000 and 6,000m.**

Statement 2 is incorrect: Magnesium constitutes the largest component followed by Iron. The components of Polymetallic nodules are **Manganese (29%) Iron (6%) Silicon (5%) and Aluminum (3%)** and other metals such as Nickel, Copper, Cobalt, Oxygen, Hydrogen, Sodium, Calcium, Magnesium, Potassium, Titanium and Barium.

Statement 3 is correct: India is implementing a long-term programme on exploration and utilization of Polymetallic Nodules (Polymetallic Nodules programme) through the Ministry of Earth Sciences.

13. Solution: (b)

Exp) Option b is the correct answer.

Manganese, widely present within the Earth's surface, boasts diverse applications. Its primary uses lie in enhancing the strength and characteristics of steel and metal alloys. As a result, the major portion of the manganese is used as an alloy component in the steel manufacturing industries.

Statement 1 is incorrect: Odisha with 44% (not Karnataka) holds the largest share of India's manganese resources, with key deposits concentrated in the Sundargarh, Koraput, and Ganjam districts. The **next leading state is Karnataka** with 22% of manganese deposits in Belgaum, North Canara, Chikmagalur, Shimoga, Chitradurg and Tumkur. **Maharashtra** is also an important producer of manganese which is mined in Nagpur, Bhandara and Ratnagiri districts.

Statement 2 is correct: The **manganese** component of the cathode material significantly impacts **the safety of battery cells.** As safety is paramount in batteries that power electric vehicles and other electronic devices, **manganese acts as a critical component of lithium ion batteries used in electric vehicles.**

14. Solution: (c)

Exp) Option c is the correct answer.

The National Waterways Act, 2016 has declared 111 inland waterways as 'National Waterways' (NWs) in the country to promote shipping and navigation on them. The total length of NWs is 20,375 kms.

Pair 1 is correct: National waterway 1 is located on the Ganga - Bhagirathi - Hooghly river system. It connects Haldia in **West Bengal with Allahabad in Uttar Pradesh.** It stretches across a total distance of 1620 km.

Pair 2 is correct: National waterway 2 lies on the river Brahmaputra having a length of 891 Km between Bangladesh Border near Dhubri and Sadiya in Assam.

Pair 3 is incorrect: National Waterway 3 also known as the West Coast Canal is a 205 km stretch of inland navigational route located in **Kerala, India. It connects Kollam and Kottapuram.**

National Waterway 5 connects the state of Odisha with West Bengal. It is a 588 km long canal and river system utilizing the East Coast Canal, **Brahmani River, Mahanadi River delta, and other waterways along its route.**

Piar 4 is correct: National Waterway 4 is located on the **Krishna-Godavari River.** It connects Puducherry with Kakinada in Andhra Pradesh. It connects the Indian states of Telangana, Andhra Pradesh, Tamil Nadu, and the union territory of Puducherry.

15. Solution: (d)

Exp) Option d is the correct answer.

At present, India stands as the **world's leading consumer of groundwater,** with approximately **85% of the rural population and 50% of the urban population relying on it for sustenance.** The overall stage of groundwater extraction

has marginally decreased from **61.6% in 2020 to 60.08% in 2022**, according to the **National Compilation of Dynamic Ground Water Resources in India.**

Statement 1 is correct- The **overexploitation of groundwater is intricately linked to heightened uranium concentration** in the water. This connection is grounded in the **natural occurrence of uranium in rocks and soil**. As groundwater permeates these geological formations, it **dissolves and transports uranium**. However, when groundwater is excessively exploited, causing a **decline in the water table**, the remaining water becomes **more concentrated**, carrying **higher levels of dissolved uranium**. Recently, higher concentration of Uranium has been found in the **Kolar and Chikkaballapur are districts in the southern part of Karnataka**, India.

Statement 2 is correct- Excessive groundwater extraction may result in the **subsidence of the land above aquifers**, causing **damage to infrastructure, disturbances in ecosystems, and heightened susceptibility of coastal areas to flooding.**

Statement 3 is correct - The research paper titled **'Drift of Earth's Pole Confirms Groundwater Depletion as a Significant Contributor to Global Sea Level Rise 1993–2010'** appeared in the **journal Geophysical Research Letters** confirms that the **withdrawal of groundwater plays a notable role in the worldwide increase in sea levels**. This occurs as **extracted groundwater is substituted by seawater,** which, due to its **higher density**, contributes to the **elevation of sea levels.**

Statement 4 is correct- A **decline in water tables** results in an **elevated concentration of contaminants in groundwater**, giving rise to water quality concerns. It leads to increased concentration of fluoride due to less water in groundwater reserve. Substances like **fluoride, arsenic, and nitrates** pose significant health risks for populations dependent on groundwater for drinking purposes.

16. Solution: (b)

Exp) Option b is the correct answer.

Option 1 is correct: Ruhr in Germany is bestowed with rich coal reserves. The **Ruhr coalfield is one of the world's largest coalfields**. Steel production and diversified chemical manufacturing constitute the other basic industries of the region. The Ruhr region is responsible for 80% of Germany's total steel production.

Option 2 is incorrect: The Boke region possesses about 57% of Guinea's total bauxite reserve. Guinea has the world's largest reserves of **bauxite**, a mineral used in the manufacture of aluminium, which is essential for the automotive and food industries.

Option 3 is incorrect: The Donbas region is an economic region in eastern Ukraine. It is endowed with a **vast amount of lithium reserves**. Ukrainian researchers have speculated that this region holds close to 500,000 tons of lithium oxide, a source of lithium, which is critical to the production of the batteries that power electric vehicles.

Option 4 is correct: The Antofagasta region in Chile is endowed with large reserves of copper. This region accounts for more than 50% of Chile's copper production. **Chile is the top copper producer** in the world with 29 percent of global copper production.

17. Solution: (c)

Exp) Option c is the correct answer.

There are two main types of iron ore found in India one is **haematite iron ore** and other is **magnetite** iron ore. **Magnetite** iron ore has a **higher content of iron up to 70 per cent** whereas **Haematite** ore has iron content of **50-60%. About 79% haematite ore deposits** are found in the **Eastern Sector** (Assam, Bihar, Chhattisgarh, Jharkhand, Odisha & Uttar Pradesh) while about **93% magnetite ore** deposits occur in the **Southern Sector** (Andhra Pradesh, Goa, Karnataka, Kerala, & Tamil Nadu).

Statement 1 is incorrect: Majority of production of iron & its products in India comes from hematite reserves. Magnetite reserves are not being exploited as these are mostly in eco fragile areas of the Western Ghats.

Statement 2 is incorrect: India's 98% magnetite reserves/ resources are located in five States, namely, Karnataka (7,802 million tonnes or 72% reserves) followed by Andhra Pradesh (1,392 million tonnes or 13%), Rajasthan (617 million tonnes or 6%), Tamil Nadu (507 million tonnes or 5%) and Goa (226 million tonnes or 2%).

Major reserves of haematite are located in Odisha (34% of the total hematite resources in the country) followed by **Jharkhand (23%) and Chhattisgarh (22%).**

Statement 3 is correct: Noamundi and Gua are important iron ore mines located in Jharkhand.

18. Solution: (d)

Exp) Option d is the correct answer.

Tertiary coals are found in **Namchik–Namphuk in Arunachal Pradesh and Kalakot in Jammu and Kashmir.** Apart from that, **Assam, Arunachal Pradesh, Meghalaya, and Nagaland** are also associated with tertiary coals. Tertiary coal is a type of coal formed during the **Tertiary geological period (66 million years ago to 2.6 million years ago)**. It is **younger and less mature** than other types of coal, such as **bituminous and anthracite**.

19. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. China has the world's largest reserves of rare earth elements. India has the world's fifth-largest reserves of rare earth elements. But it imports most of its rare earth needs in finished form from China.

Statement 2 is correct. All rare earth elements are metals, thus the term "rare earth metals" is frequently used to refer to this group. These metals frequently coexist in geologic deposits due to their many shared characteristics. Due to the fact that many of them are frequently sold as oxide compounds, they are also known as "rare earth oxides."

Statement 3 is correct. Rare earths are used as catalysts, phosphors, and polishing compounds. These are used for air pollution control, illuminated screens on electronic devices, and the polishing of optical-quality glass.

20. Solution: (d)

Exp) Option d is the correct answer.

Over the **past four or five decades,** India has experienced **significant economic transformations, impacting the country's land-use patterns.** Notably, four categories have seen growth, while four have witnessed declines. There has been an **increase in the share of area under forest, land under non-agricultural uses, current fallow lands, and net area sown.**

Statement 1 is incorrect- The Net Sown Area has increased by only **18.74 % from 1950 to 2022.** Net Sown Land Area refers to the **total area of land within a specific region within which crops are sown and harvested.** This includes land sown with crops once or multiple times in a year, but the area is **only counted once** even for multiple sowings.

Statement 2 is incorrect- With mounting pressure on land from both agricultural and non-agricultural sectors, there has been a **gradual decline over time from 1950 to 2022 in the extent of wastelands and culturable wastelands (-48.04%).** Any land that **remains uncultivated for over five years** falls into the category of Culturable Wasteland, and it can be **cultivated again after undergoing improvement through reclamation practices.**

21. Solution: (a)

Exp) Option a is the correct answer.

India is one of the richest countries in minerals resources in the world. Since India's internal structure of earth is the product of ancient hard rock's therefore almost all kinds of minerals are found here especially in Gondwana rocks.

Statement 1 is correct. Most of the metallic minerals in India occur in the peninsular plateau region in the old crystalline rocks.

Statement 2 is incorrect. Over 97 per cent of coal reserves occur in the **valleys of Damodar, Sone, Mahanadi and Godavari.**

Statement 3 is correct Petroleum reserves are **located in the sedimentary basins of Assam, Gujarat and Mumbai High** (i.e., off-shore region in the Arabian Sea). New reserves have been located in the Krishna-Godavari and Kaveri basins.

22. Solution: (c)

Exp) Option c is the correct answer.

Land-use records, managed by the land revenue department, categorize land use for the reporting area, distinct from the geographical area measured by the Survey of India. Unlike land-use records, the geographical area remains constant, determined by Survey of India measurements and unaffected by changes in land revenue estimates.

Pair 1 is incorrectly matched- The Net Sown Area and Gross Cropped Area are two important aspects of agriculture. The area of land on which crops are sown and harvested is called Net Sown Area. On the other hand, Gross Cropped Area refers to the total area sown once as well as more than once in a particular year. **In Net Sown Area crops sown more than once in the same year are counted only once. Gross cropped area is the piece of land on which a crop is grown twice, the area is counted twice.**

Pair 2 is incorrectly matched- Culturable Wasteland encompasses land that remains **uncultivated for over five years,** offering the potential for **reclamation and cultivation** after implementing improvement practices. This category denotes **arable land that has been left fallow,** and its **reintroduction into cultivation** involves **enhancing its quality through reclamation measures.**

Lands lying uncultivated for a period of one year, are included under **"current fallows"**, those uncultivated for more than one year but less than five years, are included under "other fallow land".

Pair 3 is incorrectly matched- Current Fallow refers to land **left uncultivated for one agricultural year or less,** employed as a **cultural practice to allow the land a period of rest.** During this time, the land naturally rejuvenates and recovers lost fertility through natural processes. On the other hand, **Arable** land that remains **unplanted for a period exceeding one year but less than five years is called Fallow other than Current Fallow.**

23. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect: Data show that India, with nearly 18% of the world's population, occupies about 2.4% of the total geographical area and consumes 4% of total water resources. **A World Bank report** (India Groundwater: a Valuable but Diminishing Resource) **says that India is the largest groundwater user in the world,** with an estimated usage of around 251 bcm per year, more than a quarter of the global total.

Statement 2 is correct- The agriculture sector is considered to be the largest water user in the country accounting for more than 75-80% of total water usage. This is mainly on account of cultivation of water intensive crops such as rice, wheat, sugarcane, and cotton, and very low irrigation efficiency.

24. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct. About 80 per cent of the coal deposits in India is of **bituminous type and is of non-coking grade.** In the year 2022-23, production of coking coal was 60.760 MT and production of non-coking coal was 832.430 MT.

Statement 2 is correct. Coal occurs in rock sequences mainly of two geological ages, namely Gondwana and tertiary deposits. Gondwana coal is said to be about 250 million years old. The tertiary rock systems bear coals of younger age; from 15 to 60 million years.

Statement 3 is correct. Anthracite is the best quality of coal with highest calorific value and carries **80 to 95% carbon content**. It ignites slowly with a blue flame and found **in Jammu and Kashmir**.

25. Solution: (c)

Exp) Options c is the correct answer.

Pair 1 is correctly matched: Quartz crystals find vital applications in electronic circuits, especially those demanding precise frequency control and timing. With excellent temperature and chemical stability, quartz crystals offer reliable performance in various electronic devices.

Pair 2 is correctly matched: Olivine is usually a greenish crystal, often found in basaltic rocks. It is used as a gemstone, known as peridot. **Olivine serves as a crucial refractory material in steel manufacturing due to its high melting point, low thermal expansion, and excellent chemical resistance to slag and molten metal.** Its abundance and affordability make it a cost-effective choice for furnace linings, ensuring durability in high-temperature environments.

Pair 3 is correctly matched: Feldspar is a crucial alumina source in glassmaking and ceramics. In ceramics, it serves as a flux, imparting vitreous Lustre to chinaware and tiles. Additionally, feldspar is utilized in glazes, and enamels, and as a vital mineral filler in paints, plastics, sealants, and adhesives.

26. Solution: (c)

Exp) Option c is the correct answer.

China is the world's largest producer of both gallium and germanium in the world. It produces **60% of the world's germanium and around 80% of the world's gallium**. These metals are essential for the **production of semiconductors** that are useful in manufacturing computers, smartphones, etc. Recently, China has announced to implement **export controls** on items related to gallium and germanium, which will impact the global tech industry. The restrictions could also lead to higher prices for these metals, which could make it more difficult for companies to produce high-tech products. This **shows a sign of growing trade war between China & the United States**.

Important Tips

Gallium:

1) Gallium is a soft, silvery-white metal like aluminum.
2) Gallium arsenide has a similar structure to silicon and is a useful silicon substitute for the electronics industry. It is an important component of many semiconductors. It is also used in red LEDs (light emitting diodes) because of its ability to convert electricity to light. Solar panels on the Mars Exploration Rover contained gallium arsenide.
3) Gallium nitride is also a semiconductor. It has properties that make it very versatile. It has important uses in Blu-ray technology, mobile phones, blue and green LEDs and pressure sensors for touch switches.

Germanium:

1) It is a silvery-white semi-metal. It is brittle. Germanium is a semiconductor. The pure element was commonly doped with arsenic, gallium or other elements and used as a transistor in thousands of electronic applications. Today, however, other semiconductors have replaced it.
2) Germanium oxide has a high index of refraction and dispersion. This makes it suitable for use in wide-angle camera lenses and objective lenses for microscopes. This is now the major use for this element.

27. Solution: (c)

Exp) Option c is the correct answer.

Lithium is a key component of the batteries used in electric cars. Lithium is also called as white gold.

Statement 1 is correct: Australia is the world's largest lithium producer, accounting for nearly half of global production in 2020.

Statement 2 is correct: The **South American Lithium triangle spanning Bolivia, Chile and Argentina** have the largest estimated resources. **About 56 percent** of the world's 89 million tonnes of **identified lithium resources** are found in the South American triangle, according to the US Geological Survey (USGS).

Statement 3 is incorrect: The Atomic Minerals Directorate for Exploration and Research (AMDER) under Department Atomic Energy (DAE) has undertaken **lithium exploration in Karnataka and Rajasthan.** Preliminary surveys on surface and limited subsurface exploration by AMD, have shown **presence of Lithium resources of 1,600 tonnes (inferred category) in the pegmatites of Marlagalla – Allapatna area, Mandya district, Karnataka. So, the statement is incorrect as lithium reserves have been found in India.**

28. Solution: (a)

Exp) Option a is the correct answer.

There are two main types of iron ore found in India one is **haematite iron ore** and other is **magnetite** iron ore. **Magnetite** iron ore has a **higher content of iron up to 70 per cent** whereas **Haematite** ore has iron content of **50-60%. About 79% haematite ore deposits** are found in the **Eastern Sector** (Assam, Bihar, Chhattisgarh, Jharkhand, Odisha & Uttar Pradesh) while about **93% magnetite ore** deposits occur in the **Southern Sector** (Andhra Pradesh, Goa, Karnataka, Kerala, & Tamil Nadu).

Statement 1 is incorrect: As per United Nations Framework Classification (UNFC) of mineral resources, **almost all the entire present-day production of iron & its products in India comes from hematite reserves. Magnetite reserves are not being exploited as these are mostly in eco fragile**

areas of the Western Ghats. Therefore, these reserves (magnetite) would remain locked up for the next decade till these can be considered for exploitation through special mining methods, which take care of environmental issues satisfactorily. **(Hence the statement is incorrect because there are ample reserves of magnetite iron ore in India but they are not being used due to the given reasons).**

Statement 2 is correct: Major reserves of haematite are located in Odisha (34% of the total hematite resources in the country) followed by **Jharkhand (23%) and Chhattisgarh (22%).**

Statement 3 is incorrect: Noamundi and Gua are important iron ore mines located in Jharkhand (not Odisha). The important iron ore mines in Odisha are Gurumahisani, **Sulaipet, Badampahar(Mayurbhaj), Kiruburu (Kendujhar) and Bonai (Sundergarh).**

29. Solution: (b)

Exp) Option b is the correct answer.

Polymetallic nodules, also called manganese nodules, are mineral concretions on the sea bottom formed of concentric layers of iron and manganese hydroxides around a core.

Statement 1 is incorrect: The **largest component of polymetallic nodules is Manganese (29%), Iron (6%), Silicon (5%). It contains Nickel (1.4%), cobalt (0.25%) and copper (1.3%)** along with lesser amounts of calcium, sodium, magnesium, potassium, titanium and barium.

Statement 2 is incorrect: International Seabed Authority (not International Maritime Organisation) gives licence to mine polymetallic nodules. The International Seabed Authority (ISA) is an autonomous international organisation established under the United Nations Convention on the Law of the Sea (UNCLOS). Its headquarters is located in Kingston, Jamaica. It granted **India an exclusive right to explore polymetallic nodules from seabed in the Central Indian Ocean Basin (CIOB).**

Statement 3 is correct: India recently launched Deep Ocean Mission, which among other things involves **developing a submersible vehicle that will allow a crew to plunge 6,000 metres into the ocean and hunt the floor for precious metals.** If this works, India would be among a handful of countries able to launch an underwater mission at such depths.

30. Solution: (b)

Exp) Option b is the correct answer.

Copper is an indispensable metal in the **electrical industry for making wires**, electric motors, transformers and generators. It is mixed with gold to provide strength to jewellery.

The Copper deposits mainly occur in Singhbhum district in **Jharkhand**, Balaghat district in **Madhya Pradesh** and Jhunjhunu and Alwar districts in **Rajasthan.**

The Malanjkhand Mine is a surface and underground **Copper** mine located in **Madhya Pradesh**. It is owned by Hindustan Copper.

The Banwas Mine is a copper mine located in Rajasthan. It is owned by Hindustan Copper.

The Kendadih Mine is an underground **Copper** mine located in **Jharkhand**. It is owned by Hindustan Copper.

31. Solution: (c)

Exp) Option c is the correct answer.

Lead is a soft, heavy, toxic and highly malleable metal. It is bluish white when freshly cut, but later turns into dull grey. Zinc is a silvery blue-grey metal with a relatively low melting and boiling point.

Statement 1 is incorrect: Both lead & zinc are found to occur together in an ore along with other metals, such as, silver and cadmium. Hence the statement is incorrect.

Statement 2 is incorrect: In India, there is a **short supply of lead** because of the **high demand for lead in the country due to thriving electronic industries and electronic vehicles** e.g., 74% of the lead produced by the world is consumed by the Lead Acid Battery Sector. On the other hand, India has self-sufficiency in respect of zinc. **Hence the statement is incorrect.**

Statement 3 is correct: Rajasthan is endowed with **the largest reserves of lead-zinc ore** accounting to **89.44%**, followed by **Andhra Pradesh (3.03%), Madhya Pradesh (1.98%)**, Bihar (1.52%) and Maharashtra (1.24%). Lead-Zinc ore can also be found in Gujarat, Meghalaya, Odisha, Sikkim, Tamil Nadu, Uttarakhand and West Bengal.

32. Solution: (b)

Exp) Option b is the correct answer.

Coal is formed due the compression of plant material over millions of years. It can be classified into **Gondwana, and Tertiary coals** based on the age of formation i.e., **Gondwana Coals are 200 million years old and Tertiary Coal is about 55 million years old.**

Statement 1 is incorrect: Both the coals are found in the sedimentary rocks and the difference lies in its age, Gondwana Coals are 200 million years old and Tertiary Coal is about 55 million years old.

Coal is an organic sedimentary rock that forms from the accumulation and preservation of plant materials, usually in a swamp environment.

Statement 2 is correct: Tertiary coals are **inferior** to Gondwanan coals. Tertiary coal is **lower in carbon content and higher amount of Sulphur** in comparison to Gondwana coals.

Statement 3 is incorrect: Singrauli Coalfield is spread across the districts of **Singrauli and Son Bhadra** in the Indian states of **Madhya Pradesh and Uttar Pradesh** respectively. It is one of the major producers of **Gondwana coals in India, not tertiary coal.**

33. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is incorrect: Natural gas is a fossil energy source that is formed deep beneath the earth's surface. Natural gas

contains methane, carbon dioxide, and water vapor, etc. **Natural gas is found with petroleum deposits. In India, major natural gas reserves are located in the Mumbai High, Krishna Godavari basin, Cambay basin, Tripura and Assam.**

Statement 2 is correct: The fertiliser sector is the largest consumer of natural gas today accounting for about 30 percent of consumption. The power sector which was expected to be the largest consumer of gas has fallen to third place accounting for only about 15 percent of consumption in 2021-22.

Statement 3 is correct: The challenges faced by the Natural gas production in India are ageing wells which have become less productive over time. **Private sector investment in the production of natural gas is low.** Currently, only two private entities and two public entities dominate the production of natural gas.

34. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is incorrectly matched: Kazakhstan holds the top spot for uranium production, boasting around 23% of the global share. Canada comes in second, contributing about 13% of global uranium production. **Followed by Australia and Namibia.** About two third of the world's production of uranium comes from these countries. Other major uranium producing Countries includes; Uzbekistan, Russia, Niger, China, India, South Africa, etc.

Pair 2 is incorrectly matched: The largest producer of gold across the globe is China, accounting for around 11% of the global production. It is **followed by Russia**, which is the second largest gold producing country. **Australia is at the third spot**, in terms of global gold production.

Other major gold producing countries includes; Canada, U.S.A, Ghana, Peru, Indonesia, etc.

Whereas **Switzerland is not among the leading gold producing countries. However, it holds seventh position in global gold reserves.**

Pair 3 is correctly matched: The largest aluminum producing nation across the world is China, producing more than 50% of global aluminum. The second largest aluminum producing country is India, followed by Russia.

Other major producers of aluminum: Canada, UAE, Australia, Bahrain, Norway, USA, etc.

Pair 4 is incorrectly matched: Chile holds the position for leading global copper producer, contributing about 28% of the total production. It is followed by Peru, and then China.

Important Tips

Major minerals and their largest producing countries:

1. **Bauxite:** Australia, China and Guinea.
2. **Diamond:** Russia, Botswana and South Africa.
3. **Iron ore:** Australia, Brazil and China.
4. **Lithium:** Australia, Chile and China.
5. **Coal:** China, India and USA.

35. Solution: (b)

Exp) Option b is the correct answer.

Statement I is correct: According to the Central Water Commission of India, agriculture consumes over **80% of the available water resources in the country.** India's heavy reliance on water for agriculture is evident, with estimates varying from 78% to 90% of water usage for farming.

Statement 2 is correct: Total geographical area of India is 328 million hectares out of which the cultivable area (cropland) is about 185 million ha, i.e., 56%. The remaining area is covered with mountains, forests, habitation and other uncultivable category of land. Global cropland totals 1.87 billion hectares (4.62 billion acres), according to a map released by the US Geological Survey. India has the largest cropland of any country at 179.8 million hectares, compared with 167.8 million in the US and 165.2 million in China. Russia ranks fourth, while South Asia and Europe are labelled "agricultural capitals of the world," as cropland accounts for more than 80% of some countries in those regions. In comparison, only about a fifth of land in US and China is dedicated to growing food.

Statement II is not the correct explanation of statement I: India has 18% of world population, having 4% of world's fresh water, out of which 80% is used in agriculture. According to the recent data of NITI Aayog, nearly 55% of India's total cultivable land is uses the irrigation facilities. But the irrigation efficiency is very poor in India which leads to the excess use of groundwater as well as the surface water. Also, there are no strict rules and regulations, or restrictions regarding the extraction of groundwater for agriculture purposes like the other industries. Indian agriculture is predominated by food grains which are water intensive crops e.g. Paddy. **Rice (paddy)** is a major staple crop in India and has high water requirements, typically **needing around 2,000-3,000 liters of water per kilogram of rice** produced. Additionally, other **water-intensive crops like sugarcane, cotton, and bananas are widely cultivated in India,** further contributing to the high-water consumption in agriculture. So, the presence of most cropland in the world is not the reason behind the highest use of water for agriculture in India but is high level of irrigation and low water use efficiency for irrigation.

36. Solution: (c)

Exp) Option c is the correct answer.

Central government has identified 30 critical minerals, including lithium, cobalt, nickel, graphite, tin and copper, which are essential for the country's economic development and national security.

Pair 1 is correctly matched: India imports its Vanadium mainly from **Kuwait** and **Germany. More than 50% percent of** Vanadium ore comes from Kuwait. The worldwide demand for vanadium is directly linked to the demand for steel, especially with demand for high-strength steel.

Pair 2 is correctly matched: Cobalt is imported from China, Belgium, Netherlands, US and Japan.

Cobalt is a critical mineral for India as it is used in alloys, magnets, and catalysts. More than 18 % imports of Cobalt & Alloys come from China.

Pair 3 is correctly matched: India import **Nickle from Sweden, China, Indonesia, Japan and Philippines.** Nickel is a critical mineral for India as it is used in stainless steel, superalloys, and batteries. Around 10 % of nickel imported from Sweden.

37. Solution: (a)

Exp) Option a is the correct answer.

Iron ore is a type of rock or mineral from which metallic iron can be extracted economically. It typically contains iron compounds such as oxides, carbonates, or sulfate, along with various impurities. Iron ore is **usually hard, dense, and heavy**. The **color can vary** depending on the type of iron oxide present. Important iron ores are:

1) **Hematite:** It contains about **70% metallic iron** and is considered the **best quality** iron ore. It **is reddish or coral red color.** It is found in **Dharwad and Cuddapah rock systems**. Odisha, Jharkhand, Chhattisgarh, Maharashtra, Karnataka, and Goa and important producers of Hematite ore.
2) **Magnetite**: It contains **60-70% metallic iron.** It is also known as **'black ore'**. It also occurs in the **Dharwad and Cuddapah rock systems**. Karnataka, Andhra Pradesh, Rajasthan, Tamil Nadu, and Kerala are the major producers of this variety.
3) **Limonite:** It contains **40-60% metallic iron.** It is yellowish. These are found in the **Damuda series of Raniganj coal field, Garhwal in Uttarakhand, Mirzapur in Uttar Pradesh, and Kangra Valley of Himachal Pradesh.**
4) **Siderite:** It is considered a **low-grade iron** and has **many impurities**. It contains **less than 40% metallic iron.** It is also known as **'iron carbonate'.**

38. Solution: (a)

Exp) Option a is the correct answer

Statement 1 is correct: Mica is a non- metallic mineral. Mica, any of a group of hydrous potassium, aluminum silicate minerals. It is a type of phyllosilicate, exhibiting a two-dimensional sheet or layer structure. Among the principal rock-forming minerals, **micas are found in all three major rock varieties—igneous, sedimentary, and metamorphic.**

Statement 2 is correct: Due to its excellent di-electric strength, low power loss factor, insulating properties and resistance to high voltage, mica is one of the most indispensable minerals used in electric and electronic industries.

Statement 3 is correct: Kodarma district of Jharkhand state has been famous worldwide for mica mining, especially for ruby mica. The district had the monopoly in producing mica for years and mica was exported to many countries worldwide. Mica is also found in the area of Dhab, Dhodhakola,Khalagthambi, Dibour, Bandarchua, etc.

Statement 4 is incorrect: The **largest mica producer in the world is China,** producing an estimated 100,000 metric tons of mica. India ranked 6th with 16000 metric Tonne production. For over hundred years, India has enjoyed the monopoly in the production and export of sheet mica in the world. There has been a steady downfall in mica production. This declining trend could be attributed to the fall in the demand for natural mica in the world market due to technological improvements that facilitate use of reconstituted mica and the emergence of mica substitutes. However, there are sufficient resources in the country to meet the domestic requirement and export demand.

39. Solution: (c)

Exp) Option c is the correct answer.

In India, monazite is the principal source of rare earth minerals and thorium. The resource estimates of monazite in the beach and inland placer deposits have been enhanced from 11.935 million tonnes in 2012 to 12.47 million tonnes in 2016 which corresponds to about 1 million tonnes of thorium oxide.

Table – 1: Resources of Monazite

(In million tonnes)

State	Resources*
All India	**12.47**
Andhra Pradesh	3.69
Gujarat	0.003
Jharkhand	0.21
Kerala	1.84
Maharashtra	0.004
Odisha	3.06
Tamil Nadu	2.46
West Bengal	1.20

Option 1 is correct. Kerala is the state with the significant reserves of monazite mineral in India. It is located along the southwestern coast and is home to the Monazite sands, which are rich in thorium.

Option 2 is correct. Odisha has significant monazite reserves with the golden beaches of Odisha in eastern India also home to the prized mineral.

Option 3 is incorrect. Assam is not known for significant monazite reserves.

Option 4 is correct. Tamil Nadu, located on the southeastern coast, is a state **rich in Monazite sands.**

Option 5 is correct. Andhra Pradesh has significant reserves of monazite along its coastline.

40. Solution: (a)

Exp) Option a is the correct answer.

Biofuels refers to renewable fuels derived from biomass: plants or agricultural, animal,

domestic, and industrial biowaste. Biofuels are significantly cleaner than conventional

fossil fuels.

Pair 1 is correct. First generation biofuels are mainly based on microbial fermentation of edible feedstocks, rich in starch and sucrose, such as wheat, corn, sugarcane, rapeseed, soy, or palm oil. Though the process of conversion is easy but use of food sources in the production of biofuels creates food shortages

Pair 2 is correct. Second-generation biofuels are derived from non-edible materials such as agricultural and forest residues and crops grown for biofuel purpose. It also uses other waste streams for example, from food industry like wheat bran, animal fats, or wastes of cooking and frying oil. Hence, second-generation biofuels do not compete with food resources

Pair 3 is incorrect. Third-generation biofuels are mainly derived from microalgae and cyanobacteria biomass. These can be used to naturally generate alcohols and lipids to transform into biodiesel or any other high energy fuel product

Pair 4 is incorrect. Fourth-generation biofuels are derived from engineered plants and microorganisms. It encompasses the use of genetic engineering to increase desired traits of organisms used in biofuel production.

41. Solution: (b)

Exp) Option b is the correct answer.

Minor minerals are those that are declared as such by the Central Government in exercise of the powers conferred by the Mines & Minerals (Regulation & Development) Act, 1957.

Recently, the Ministry of Mines has shifted minerals - Barytes, **Felspar**, **Mica** and Quartz - from the list of minor minerals to the category of major minerals.

Option 1 is incorrect: Earlier classified as a minor mineral, **Felspar** is widely used in the ceramics, glass, and enamel industries. However, since it is found in pegmatite rocks, which also contain critical minerals like lithium, beryl, and niobium, the government has reclassified it as a **major mineral** to regulate its extraction more effectively.

Option 2 is incorrect: Mica is used in various industries, including electronics, cosmetics, and insulation. It is also found in pegmatite formations, making it a potential source of critical minerals. To prevent unreported extraction of these valuable resources, Mica has been reclassified as a **major mineral** recently.

Option 3 is correct: Dolomite remains a **minor mineral** and is used in construction, steel production, and agriculture.

Option 4 is correct: Gypsum is a minor **mineral** used in cement manufacturing, agriculture, and plaster production.

Important Tips

Minor Minerals list: Bentonite, Calcite, Corundum & Sapphire, Diaspore, Dolomite, Dunite & Pyroxenite, Fireclay, Fuller's Earth, Granite, Gypsum & Selenite, Kaolin, Ball Clay, Other Clays & Shale, Laterite, Marble, Ochre, Other Calcareous Materials, Pyrophyllite, Slate, Sandstone & Other Dimension Stones, Talc, Soapstone & Steatite. ***(Note: Barytes, Felspar, Mica, and Quartz have been reclassified as major minerals as of February 2025.)***

Major Minerals include:

- **Fuel Minerals:** Coal, Lignite, Natural Gas, Petroleum (Crude).
- **Metallic Minerals:** Bauxite, Chromite, Copper Ore, Gold, Iron Ore, Lead Concentrates, Manganese Ore, Silver, Tin Concentrates, Zinc Concentrates, Tungsten Concentrates.
- **Non-Metallic Minerals:** Agate, Andalusite, Apatite, Asbestos, Ball Clay, Calcite, Kyanite, Laterite, Limestone, Limestone Kankar, Lime Shell, Magnesite, Mica (Crude), Ochre, Phosphorite, Pyrites, Pyrophyllite, Quartz, Impure Quartz, Quartzite, Fuchsite Quartzite, Salt (Rock), Salt (Evaporated), Shale, Sillimanite, Slate, Steatite, Vermiculite, Wollastonite.

42. Solution: (b)

Exp) Option b is the correct answer.

India is rich in mineral resources, with different states contributing to the production of various minerals that are essential for industries such as metallurgy, electronics, and manufacturing.

Pair 1 is correct. Rajasthan holds the largest copper ore reserves in India, accounting for 868 million tonnes (52.25%) of the total. It is followed by Madhya Pradesh, with 387 million tonnes (23.28%), and Jharkhand, which has 251 million tonnes (15.14%).The major copper mines in the state are operated by Hindustan Copper Limited (HCL) at Khetri, Kolihan, and Banwas in the Jhunjhunu district. Copper is a vital industrial metal used in electrical wiring, plumbing, and alloy production.

Pair 2 is incorrect. Rajasthan has the **largest lead-zinc ore reserves** in India, amounting to 684.65 million tonnes (89.32%). It is followed by Andhra Pradesh with 22.69 million tonnes (2.96%), Madhya Pradesh with 19.06 million tonnes (2.48%), Bihar with 11.43 million tonnes (1.49%), and Maharashtra with 9.27 million tonnes (1.20%).The Zawar Mines and Rampura-Agucha Mines in Rajasthan are among the world's largest sources of lead and zinc, operated by Hindustan Zinc Limited (HZL). Lead is used extensively in batteries, radiation shielding, and pigments.

Pair 3 is correct. Tungsten-bearing mineral resources in India are primarily found in **Karnataka (41%)**, followed by **Rajasthan (27%)**, **Andhra Pradesh (17%)**, and **Maharashtra (11%)**. The remaining 4% of the resources are distributed across **Haryana, Tamil Nadu, Uttarakhand, and West Bengal**. Tungsten is a rare metal used in electrical, military, and aerospace applications due to its high melting point and hardness.

Pair 4 is incorrect. Rajasthan holds the largest share of ore reserves of silver in India, accounting for 86% of the total. It is followed by Karnataka (5%), Jharkhand (4%), and Andhra Pradesh (3%), making them the next major states in terms of reserves.The majority of India's silver production comes as a by-product from lead-zinc mining at Hindustan

Zinc Limited's mines in Rajasthan. Silver is widely used in jewelry, electronics, photography, and solar panels.

43. Solution: (b)

Exp) Option b is the correct answer.

Option a is incorrect: Wolfram is an ore of Tungsten. Resources of tungsten bearing minerals are mainly distributed in Karnataka (42%), Rajasthan (27%), Andhra Pradesh (17%) and Maharashtra (9%).

Option b is correct: Chromite is the commercially viable ore of chromium (Cr) which is chemically known as iron chromium oxide (FeCr2O4). Chromite is an important mineral that is the primary ore of chromium, a metal used in various industrial applications. **Chromite is the primary element used in the production of stainless steel, refractories, ceramics, chemicals, electrodes**, and foundries. **India holds about 2.5% of the world's chromite resources**, with **Odisha** contributing a significant **98.39% of the country's reserves**. The majority of these reserves are located in the **Sukinda Valley**.

Option c is incorrect: Zinc concentrate is an important ore of Zinc. Almost entire production of zinc concentrates is reported from Rajasthan.

Option d is incorrect: Manganese ores of major commercial importance are: (i) pyrolusite (ii) psilomelane (iii) manganite (Mn2O3 (iv) braunite

Statewise, Odisha tops the total resources with 44% share followed by Karnataka 22%, Madhya Pradesh 13%, Maharashtra 8%, Andhra Pradesh 4% and Jharkhand & Goa 3% each.

44. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is correct: Phosphogypsum is a waste byproduct generated during the **production of phosphoric acid**, which is used in making **phosphate fertilizers**. It is formed when **phosphate rock reacts with sulfuric acid** in the manufacturing process.

Statement 2 is correct: Phosphogypsum contains naturally occurring radioactive elements such as **uranium, thorium, and radium**. These radioactive elements originate from the **phosphate rock** and remain in the byproduct after processing. The **presence of radioactivity** limits its widespread use in construction and agriculture without prior treatment.

Statement 3 is incorrect: Phosphogypsum has been approved by the Indian Road Congress (IRC) for **road construction** for a trial period of **three years**. A road was constructed using **neutralized phosphogypsum**, and its performance was **evaluated by the Central Road Research Institute (CRRI)**. Based on CRRI's report, **IRC accredited phosphogypsum** as a **suitable material** for highway construction. **The National Highways Authority of India (NHAI)** is conducting field trials to assess its **long-term performance and durability** in national highway construction.

45. Solution: (b)

Exp) Option b is the correct answer.

Pair 1 is correct: Galena (PbS) is the **primary ore of lead** and also a significant source of silver. It has a metallic luster and high density, making it easy to identify. Major lead mining regions in India include Rajasthan (Zawar mines) and Andhra Pradesh.

Pair 2 is incorrect: Chalcopyrite ($CuFeS_2$) is a **copper ore**, not zinc. It is a brassy yellow mineral, often mistaken for pyrite (fool's gold) due to its appearance. Sphalerite is the main ore for zinc. India's major zinc deposits are found in Rajasthan (Rampura Agucha mines), which is among the largest zinc producers globally.

Pair 3 is correct: Cinnabar (HgS) is the **chief ore of mercury**, known for its bright red color. It was historically used as a red pigment (vermilion) before its toxicity was discovered. Mercury extraction from cinnabar involves roasting the ore to release mercury vapor, which is then condensed into liquid mercury. Significant mercury deposits are rare, but globally they are found in Spain, Italy, and China.

46. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct: Lac is a natural resin produced by the insect Laccifer lacca. They feed on the sap of certain trees, primarily those in the Fabaceae (legume) family, and secrete a resinous substance called lac as a protective coating. Lac is a versatile material with various applications like cosmetics, traditional medicine etc.. These trees grow extensively in the Chhottanagpur plateau.

Statement 2 is correct: India is the largest producer of lac in the world. India accounts for more than 80% of the world's lac production. More than 90% of total production **is exported** to the nations like USA, Russia, Germany, and UK.

Statement 3 is correct: Among the lac-growing states, **Jharkhand state ranks 1st (54.60%)** followed by Chhattisgarh (18.37%), Madhya Pradesh (13.03%), West Bengal (5.57%), Maharashtra (4.50%), and Odisha (3.55%). **These six states contribute more than 99 % of the total lac production in India.**

Statement 4 is correct: Lac has varied applications. It can be used in medicines, plastics, bangle making, **electrical insulation materials**, dyeing silk, paints, sealing wax, leather and wood finishing, etc. Hence, the given statement is correct.

47. Solution: (d)

Exp) Option d is the correct answer.

Minerals are classified into **metallic** and **non-metallic** types. **Metallic minerals** contain metal elements and are divided into **ferrous** (contain iron) like **iron ore, manganese, chromite, nickel, cobalt**, and **non-ferrous** (do not contain iron) such as **gold, silver, copper, lead, bauxite, zinc**. **Non-metallic minerals** lack metal elements and include **limestone, dolomite, gypsum, mica, phosphates, salt.**

1. **Magnesite ($MgCO_3$)** is a **non-metallic mineral** used in **refractory bricks** for **steel** and **cement** industries, **fire-proof linings**, **artificial stones**, and **electrical insulation**. Major deposits in India are in **Tamil Nadu (67.5%, Salem Chalk Hills)**, **Uttarakhand (25.4%, high-quality)**, **Karnataka (3.3%)**, and **Rajasthan (minor quantities)**.
2. **Kyanite (Al_2SiO_5)** is a **non-metallic aluminosilicate mineral** essential for **refractory materials**, **ceramics**, **spark plugs**, **glass**, **cement**, and **electrical industries**. **Jharkhand** is the **largest producer (90%, Singhbhum)**, with smaller deposits in **Maharashtra (Nagpur, Bhandara)**, **Odisha**, **Tamil Nadu**, and **Andhra Pradesh (low-grade)**.
3. **Sillimanite (Al_2SiO_5)** is a **non-metallic aluminosilicate mineral** widely used in **refractories**, **ceramics**, **glass**, **cement**, **paints**, **plastics**, **partition blocks**, and as a **soil surface plaster**. **Odisha** leads production (**56%**), followed by **Kerala (one-third)**, with other deposits in **Tamil Nadu**, **Andhra Pradesh**, **Uttar Pradesh**, and **Assam**, along with **smaller reserves** across **various states**.

48. Solution: (d)

Exp) Option d is the correct answer.

The Mines and Minerals (Development and Regulation) Amendment Bill, 2023 was passed to make amendments to the Mines and Minerals (Development and Regulation) Act, 1957. The MMDR Act, 1957 was also comprehensively amended in 2015 to bring several reforms in the mineral sector.

Statement-I is incorrect. Any enterprise can mine Beryllium and Titanium bearing minerals in India, and not just Central Public Sector Enterprises. This is because they are no longer considered to be atomic minerals. The 2023 amendment to the 1957 act removed minerals of lithium, beryllium, titanium, niobium, tantalum and zirconium from the list of atomic minerals. Upon removal of these minerals from the list of atomic minerals, exploration and mining of these minerals will be open to private sector. As a result, exploration and mining of these minerals is expected to increase significantly in the country.

Statement-II is correct. As per the Mines and Minerals (Development and Regulation) Act, 1957, only Central Public Sector Enterprises can mine minerals identified as atomic minerals. Hence, exploration and mining of these minerals is very limited. However, there is a need to vigorously increase exploration and production of some of these minerals to meet the growing demands of the country wherein involvement of private sector can be a force multiplier. Expansion in exploration and mining activities of these minerals will consequently increase their availability to the atomic sector also.

Thus, Statement-I is incorrect but Statement-II is correct.

49. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: Lignite is also known as brown coal as it is brown in colour. **The highest reserves of lignite are found in the state of Tamil Nadu**, followed by Rajasthan. Tamil Nadu accounts for more than 80% of India's lignite reserves.

(Lignite Resources in million tonne)

State	Measured (331)	Indicated (332)	Inferred (333)	Resource
Pondicherry	00	405.61	11.00	416.61
Tamilnadu	5023.09	21885.01	10688.48	37596.58
Rajasthan	1203.85	3108.55	2273.84	6586.24
Gujarat	1278.65	283.7	1159.7	2722.05
J&K	00	20.25	7.30	27.55

Statement 2 is correct: Recently, Chhattisgarh-based Coal India Limited (CIL) subsidiary South Eastern Coalfields Limited's (SECL) Gevra and Kusmunda coal mines have secured the 2nd and 4th spot in the list of the world's 10 largest coal mines. **The Gevra coal mine, which is the largest coal mine in India, is located in the state of Chhattisgarh.**

Statement 3 is incorrect: The top three states with highest coal reserves in India are Odisha, Jharkhand, Chhattisgarh, which account for approximately 69% of the total coal reserves in the country. Madhya Pradesh has around 8% of India's coal reserves.

(Coal Resources in million tonne)

State	Measured (331)	Indicated (332)	Inferred (333)	Resource
Odisha	52046.19	37536.32	4936.08	94518.59
Jharkhand	55749.18	26994.01	5094.91	87838.10
Chhattisgarh	37236.35	42293.97	1243.55	80773.87
West Bengal	17459.34	12698.82	3775.12	33933.28
Madhya Pradesh	15279.27	12456.93	4482.33	32218.53

50. Solution: (b)

Exp) Option b is the correct answer

- Strategic petroleum reserves (SPRs) are stockpiles of crude oil maintained by countries ensuring a stable supply of crude oil during times of supply disruptions.
- In India, the Strategic petroleum reserves are located in the following locations:

Visakhapatnam, Andhra Pradesh - 1.3 MMT capacity

Mangaluru, Karnataka - 1.5 MMT capacity

Padur, Karnataka - 2.5 MMT capacity

- India's existing Strategic petroleum reserve facilities have a combined capacity of 5.3 Million Metric Tonnes (MMT) of crude oil.
- In July 2021, Government of India approved the establishment of two additional commercialcum-strategic petroleum reserve facilities with total storage capacity of 6.5 MMT at **Chandikhol** (4MMT) in Odisha and **Padur**-II (2.5 MMT) in Karnataka, on a Public Private Partnership mode.

51. Solution: (a)

Exp) Option a is the correct answer.

Groundwater is a **critical resource for India**, supporting **agriculture, industries, and drinking water needs**. The dependence on groundwater, particularly for irrigation,

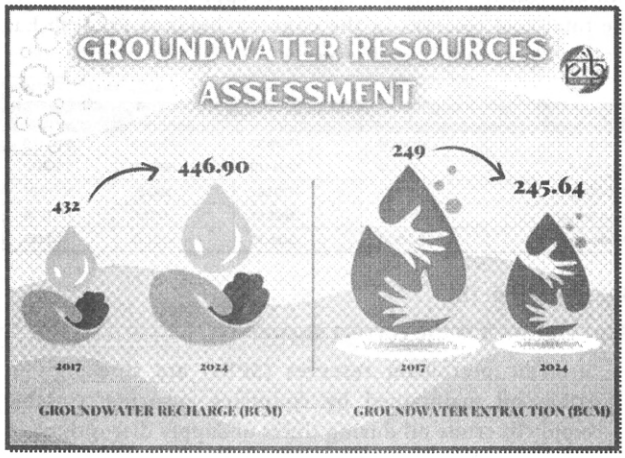
makes it essential to regulate and manage this resource effectively.

Statement 1 is correct. India is the **largest consumer of groundwater worldwide**, extracting about **25% of global groundwater extraction**. This makes India highly dependent on underground water sources.

Statement 2 is correct. The Total Annual Ground Water Extraction of the entire country for the year 2023 has been estimated as 241.34bcm. The **agriculture sector is the largest consumer of groundwater resources, accounting for 87% of the total annual groundwater extraction**, which amounts to 209.74 bcm.

The agricultural sector **relies heavily on groundwater**, especially in **Punjab, Haryana, Uttar Pradesh, and Rajasthan**, where tube wells and borewells are common.

Statement 3 is incorrect: As per the Dynamic Ground Water Resource Assessment Report of the Country for the Year 2024, the total Annual GW Recharge has increased (15 BCM) substantially and **Extraction has declined (3 BCM) in 2024 from 2017 assessment**.



However, there is slight reduction in recharge and increase in extraction in the present assessment year compared to the preceding year (2023).

52. Solution: (b)

Exp) Option b is the correct answer.

All three mines given are well known for **copper mining.**

- **Kolihan Mine** is an important underground copper mine located in the **Jhunjhunu district of Rajasthan**. It is a part of the **Khetri Copper Complex (KCC)** .
- **Surda Mine** is a significant copper mine located in the **East Singhbhum district of Jharkhand**. It is part of the Singhbhum Copper Belt, one of India's oldest and most important copper-producing regions.

53. Solution: (b)

Exp) Option b is the correct answer.

Bauxite is a sedimentary rock and the principal ore for aluminium production. India has significant bauxite reserves, with major deposits located in Odisha, Jharkhand, Chhattisgarh, Madhya Pradesh, Gujarat, and Maharashtra. Odisha is the largest producer of bauxite in India, with key mining areas in Kalahandi, Sambalpur, Koraput, and Rayagada.

Statement 1 is incorrect: India is **not** the largest producer of Bauxite. According to the **World Mineral Production, 2018-22 (British Geological Survey):**

Global Bauxite production ranking:

1. Australia

2. China

3. Guinea

4. Brazil

5. India

Statement 2 is correct: Bauxite is the primary source of gallium, a rare metal used in **semiconductors, LEDs, solar panels, and high-tech electronics**. Gallium is typically extracted as a **byproduct of aluminium refining** during the **Bayer process**, where it is found in small concentrations in **bauxite ores**. The demand for gallium has increased due to its use in **5G technology, aerospace applications, and advanced electronics**.

54. Solution: (a)

Exp) Option a is the correct answer.

A mineral is a natural substance of organic or inorganic origin with definite chemical and physical properties. India has a rich and diverse mineral resource base, contributing significantly to its industrial and economic development. The distribution of minerals in India is highly uneven and is primarily concentrated in specific geological formations.

Pair 1 is correct: Coal is one of India's key mineral resources, with approximately 80% of its deposits being of the bituminous type and primarily non-coking in grade. The most significant Gondwana coalfields are concentrated in the Damodar Valley. Among them, **Singrauli, located in Madhya Pradesh** (with a portion extending into Uttar Pradesh), is one of the country's major coal mining centres.

Pair 2 is incorrect: The Ratnagiri district/Ratnagiri Mines are well known for the mining of Bauxite, Silica Sand and fireclay and not for copper.

Pair 3 is incorrect: Malanjkhand is copper mines (not Bauxite mine) located in Balaghat district of Madhya Pradesh. Khetri mines in Rajasthan and Singhbhum district of Jharkhand are other leading producers of copper.

55. Solution: (c)

Exp) Option c is the correct answer.

Statement-I is correct: India is one of the leading producers of iron ore in Asia. **China is the top producer of iron ore in Asia followed by India.** In 2021, the world production of iron ore was 3,108 million tonnes. Australia with 922 million tonnes (30%), **China 850 million tonnes (27%)**, Brazil 431 million tonnes (14%), **India 198 million tonnes (6%) were the principal producers in the world.**

Statement-II is incorrect: India is endowed with fairly abundant resources of iron ore. **However, China has the largest reserves of iron ore in Asia.** China has reserves of crude iron ore of about 20000 million tonnes whereas India has reserves of 5500 million tonnes.

(**Note:** NCERT mentions that India has the largest iron ore reserves in Asia. It seems data has not been updated. Note that, as per Indian Minerals Year book 2022, China has top iron ore reserves in Asia and is also leading producer of iron ore in the continent.)

56. Solution: (b)

Exp) Option b is the correct answer.

Coal is a one of the important minerals which is mainly used in the generation of thermal power and smelting of iron ore. Coal occurs in rock sequences mainly of two geological ages, namely Gondwana and tertiary deposits.

Statement 1 is incorrect: India is the 5th largest country in terms of coal deposits. The United States has the largest coal reserves in the world.

Ranking	Country	million short tons
1	United States	273,244
2	Russia	178,757
3	China	173,108
4	Australia	164,764
5	India	140,795

Statement 2 is incorrect: India's coal reserves are predominantly composed of bituminous and sub-bituminous coal, with a small percentage of anthracite. **Anthracite is the highest grade of coal, but it constitutes a very small portion of India's coal reserves. About 80 per cent of the coal deposits in India is of bituminous type and is of non-coking grade.**

Statement 3 is correct: The Damodar Valley, located in Jharkhand and West Bengal, is one of the richest coal-bearing regions in India. It is often compared to the Ruhr Valley in Germany, which is also a major coal-producing region.

57. Solution: (b)

Exp) Option b is the correct answer.

- **Naharkatiya, Ankaleshwar, and Kosamba are well-known oil-producing regions in India.**
- **Naharkatiya**, located in Assam, is **one of the earliest oil fields** discovered in the country and has been a significant contributor to India's crude oil production.
- **Ankaleshwar**, situated in Gujarat's Bharuch district, is the **largest oil field in the state** and plays a crucial role in petroleum extraction.
- Similarly, **Kosamba**, also in Gujarat, **is known for its oil and natural gas reserves.**
- These regions are vital to India's energy sector, helping to meet domestic oil demands and support industrial growth. .

58. Solution: (b)

Exp) Option b is the correct answer.

Pyrolusite and braunite are both important ores of Manganese. Manganese occurs as silvery grey in colour and is very hard and brittle in nature. It is always available in combination with iron, laterite and other minerals. Manganese in alloy form is an essential input in steel making. Presently, **India is one of the major importers of manganese ore in the world.**

Manganese ores of major commercial importance are: (i) pyrolusite (Mn about 63.2%) (ii) psilomelane (Mn commonly 45– 60%); (iii) manganite (Mn about 62.4%); and (iv) braunite (Mn about 62%).

Statewise, **Odisha tops the total reserves/resources with a 34%** share followed by Karnataka (24%), Madhya Pradesh (12%), Maharashtra (12%), Goa (7%), Andhra Pradesh (6%) and Jharkhand (3%). Rajasthan, Gujarat, Telangana and West Bengal together shared the remaining 2% resources.

59. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: The Dharwar rock system is the **most ancient metamorphosed sedimentary rock system in India.** It dates back to the Archaean eon, which spans from about **3.1 to 1 billion years ago.** This rock system is primarily composed of metamorphosed sedimentary rocks, it also contains some metamorphosed rocks of igneous origin.

Statement 2 is incorrect: Dharwar rocks of Himalayas are found in Kashmir, Garhwal and Nepal- Sikkim Himalayas, where they are recognized by the name of Salkhala series, Vaikrita series, Juthog series and Daling series respectively.

The **Dharwar system is predominantly found in the peninsular region of India, particularly in the Dharwar-Bellary-Mysore belt of Karnataka.**

However, **it also extends beyond the peninsular region,** with occurrences in various states such as Jharkhand (Ranchi, Hazaribagh), Madhya Pradesh (Balaghat, Rewa), Chhatisgarh (Bastar, Dantewara, Kanker), and Odisha (Sundergarh, Keonjhar). Additionally, it is **well represented in the Himalayas,** including both the central and northern zones, as well as in the Meghalaya plateau

Statement 3 is correct: The Dharwar system holds significant economic importance due to its abundance of valuable minerals. These **minerals include high-grade iron ore, manganese, copper, lead, gold, quartzites, slates, mica, and others.** The presence of these minerals within the Dharwar system has contributed immensely to the economic development of regions where these rocks are found.

60. Solution: (b)

Exp) Option b is the correct answer.

In India there are primarily two types of mining practices - surface mining (also called open-cast mining) and underground mining.

Open-cast mining is a surface mining technique that extracts minerals from an open pit in the ground.

When the ore lies deep below the surface, an underground mining method (shaft method) has to be used. In this method, vertical shafts have to be sunk, from where underground galleries radiate to reach the minerals. Minerals are extracted and transported to the surface through these passages.

Statement 1 is incorrect. Open-cast mining is comparatively safer and less riskier than the underground mining as it doesn't involve digging of shafts. Underground mining requires specially designed lifts, drills, haulage vehicles, ventilation systems for safety and efficient movement of people and material. **This method is risky.** Poisonous gases, fires, floods and caving in lead to fatal accidents.

Statement 2 is correct. Open-cast mining is the easiest and the cheapest way of mining minerals as it involves mining of minerals that occur close to the surface. Overhead costs such as safety precautions and equipment is relatively low in this method. The output is both large and rapid.

Statement 3 is correct. Underground mines are operated over a smaller area, and it affects a small area compared to the Open cast method. **Thus, it causes less deforestation, less topsoil removal, and less impact on the ecosystem of surrounding areas than the Open cast method.**

61. Solution: (a)

Exp) Option a is the correct answer.

Uranium (chemical symbol U) is a naturally occurring radioactive element. Uranium has three primarily naturally occurring isotopes: U-238, U-235 and U-234. Uranium is used in nuclear power generation. Specifically, U-235 can be concentrated in a process called "enrichment," making it "fissile" and suitable for use in nuclear reactors or weapons.

Important Tips

Some important sites of Uranium deposits in the world are discussed below:

1. Canada's Athabasca Basin hosts several of the highest-grade uranium deposits on the planet. Located primarily in the mining friendly jurisdiction of Saskatchewan, the Athabasca Basin covers an area of almost 100,000 square kilometers and hosts the world's largest producing uranium mine, Cigar Lake.
2. Kazakhstan has 15% of the world's uranium resources and an expanding mining sector. Chu-Sarysu basin/ province of Kazakhstan has more than half the country's known resources.
3. The McArthur River mine is the world's largest high-grade uranium mine located in northern Saskatchewan, Canada. The mine was discovered in 1988 and has been in production since 1999.

62. Solution: (b)

Exp) Option b is the correct answer. answer.

The overall contribution of rainfall to the country's annual ground water resource is 68% and the share of other resources, such as canal seepage, return flow from irrigation, recharge from tanks, ponds and water conservation structures taken together is 32%

Option a is incorrect - The new guidelines prohibit new industry and mining projects in over-exploited zones and makes it mandatory for existing industries, commercial units and big housing societies to take 'no objection certificate' (NOC). **The domestic consumers, rural drinking water schemes, armed forces, farmers and micro & small enterprises (that withdraw up to 10 m3 water per day), however, are exempted from the requirement of a no objection certificate** from the Central Ground Water Board (CGWB).

Option b is correct - Section 7(g) of the Easement Act, 1882 states that every owner of land has the right to collect and dispose within his own limits all water under the land and on its surface which does not pass in a defined channel. The legal consequence of this law is that the owner of the land can dig wells in his land and extract water based on availability and his discretion. 24 Additionally, landowners are not legally liable for any damage caused to the water resources as a result of overextraction.

Option c is incorrect - India is the larger extractor of ground water but is not the largest exporter. It is third largest exporter of ground water – 12% of world total. Pakistan is the largest exporter of ground water. However, looking at the total export of virtual water, India is at the top position.

Option d is incorrect - India accounts for 16 per cent of the world's population living in less than 2.5 per cent of the global area, and has just 4 per cent of the global water resources. According to the Central Water Commission (CWC), the estimated water resources potential of the country, which occurs as natural runoff in the rivers, is 1,999 billion cubic metres. **Of this, the estimated utilisable resources are 1,122 billion cubic metres per year — 690 BCM per year surface water and 432 BCM per year replenishable groundwater.**

Important Tips

Table 4: Major central level water institutions responsible for ground water management

Institution	Role
Central Water Commission	Initiating and coordinating schemes for the conservation and utilisation of water resources in the country in collaboration with state governments; and monitoring water quality
Central Ground Water Board	Developing and disseminating technology related to sustainable use of ground water; monitoring and implementing policies for the sustainable management of ground water resources; estimating ground water resources
Central Ground Water Authority	Constituted under Section 3(3) of the Environment (Protection) Act, 1986 to regulate and control development and management of ground water resources; can resort to penal actions and issue necessary regulatory directives
Central Pollution Control Board	Implementation of the Water (Prevention and Control of Pollution) Act, 1974 which seeks to restore water quality

Source: Ministry of Water Resources; Lok Sabha Question 2157, March 10, 2015; PRS.

The District Collector in every state is the point of contact for the Central Ground Water Board. The Collector has the powers to implement the suggestions or corrective measures provided by the Central Ground Water Board.

63. Solution: (c)

Exp) Option c is the correct answer.

About 95 per cent of total reserves of iron ore is located in the States of Odisha, Jharkhand, Chhattisgarh, Karnataka, Goa, Telangana, Andhra Pradesh and Tamil Nadu.

Pair 1 is correct. In Odisha, **iron ore** occurs in a series of hill ranges in Sundergarh, Mayurbhanj and Jhar. The important mines are Gurumahisani, Sulaipet, **Badampahar** (Mayurbhaj), Kiruburu (Kendujhar) and Bonai (Sundergarh).

Pair 2 is correct. Bauxite is found mainly in tertiary deposits and is associated with laterite rocks occurring extensively either on the plateau or hill ranges of peninsular India and also in the coastal tracts of the country. Odisha happens to be the largest producer of Bauxite. **Lohardaga in Jharkhand** have rich Bauxite deposits. Gujarat, Chhattisgarh, Madhya Pradesh and Maharashtra are other major producers.

Bauxite is the ore, which is used in manufacturing of aluminium.

Pair 3 is correct. The Copper deposits mainly occur in Singhbhum district in Jharkhand, Balaghat district in Madhya Pradesh and **Jhunjhunu and Alwar districts in Rajasthan.** Minor producers of copper are Agnigundala in Guntur District (Andhra Pradesh), Chitradurg and Hasan districts (Karnataka) and South Arcot district (Tamil Nadu).

Copper is an indispensable metal in the electrical industry for making wires, electric motors, transformers and generators. It is **alloyable, malleable and ductile**. It is also mixed with gold to provide strength to jewellery.

64. Solution: (a)

Exp) Option a is the correct answer.

Coal is one of the important minerals which is mainly used in the generation of thermal power and smelting of iron ore.

Statement 1 is correct. Coal occurs in rock sequences mainly of two geological ages, namely Gondwana and tertiary deposits. Around 98 per cent of India's total coal reserves are from Gondwana times. This coal was formed about 250 million years ago.

Tertiary coal is of younger age. It was formed from 15 to 60 million years ago. **Coal has been of 4 types** Peat, Lignite, Bituminous & Anthracite Coal. This division is based on carbon, ash and moisture content.

Statement 2 is correct About 80 per cent of the coal deposits in India is of bituminous type and is of non-coking grade.

Statement 3 is incorrect. Bituminous has **a low level of moisture content** with **60 to 80% of carbon content** and **has a high calorific value**. Jharkhand, West Bengal, Odisha, Chhattisgarh and Madhya Pradesh have deposits of Bituminous.

Statement 4 is correct. Anthracite is generally not found in the Gondwana coal fields. In India, it is found only in Jammu and Kashmir and that too in small quantity.

65. Solution: (a)

Exp) Option a is the correct answer.

Manganese is a silver metallic element. It occurs in many minerals such as manganite, sugilite, rhodonite, rhodochrosite, and pyrolusite.

Indian manganese ore deposits occur mainly as metamorphosed bedded sedimentary deposits associated with Gondite Series (Archaeans) of Madhya Pradesh (Balaghat, Chhindwara & Jhabua districts), Maharashtra (Bhandara & Nagpur districts), Gujarat (Panchmahal district), Odisha (Sundergarh district).

Statement a is correct. The Dharwar systems of rocks are highly metalliferous. They bear out gold, iron ore, **manganese** mica, cobalt, chromium, copper, tungsten, lead, nickel, precious stones and budding stones. The Dharwar system of rocks occurs in scattered patches in: (i) southern Deccan, (ii) central and eastern parts of the Peninsula, (iii) north- western region, and (iv) the Himalayan region.

Statement b is incorrect. Orissa is the largest producer and produces over 37 per cent manganese ore of India. It is obtained from Gondite deposits in Sundargarh district and Kodurite and Khondolite deposits in Kalahandi and Koraput Districts.

Statement c is incorrect. The most important manganese ore is **pyrolusite**. Limonite is an ore of iron. Other important manganese ores are the oxides pyrolusite, romanechite, manganite, and hausmannite and the carbonate ore rhodochrosite. Rhodonite and braunite, both silicate ores, are frequently found with the oxides.

Statement d is incorrect. On Earth, manganese is never found as a free metal, but it is found in a number of minerals. The most important of these minerals is pyrolusite, the main ore mineral for manganese. Manganese is essential to iron and steel production.

66. Solution: (d)

Exp) Option d is the correct answer.

Pair 1 is correctly matched. The famous gold mines in India are **Kolar (Karnataka), Hutti (Karnataka), Ramagiri(Andhra Pradesh)**, and Lawa (Jharkhand).

The largest reserves of gold ores are located in Bihar (44 per cent), followed by Rajasthan (25 per cent).

Pair 2 is correctly matched. The five largest silver mines by production in India are **Sindeshar Khurd (Rajasthan),** Rampura Agucha Mine (Rajasthan), Rajpura Dariba Mine (Rajasthan) **Zawwar (Rajasthan), Hutti (Karnataka).**

Pair 3 is correctly matched. The famous diamond mines in India are Panna in Madhya Pradesh. **In India, the diamond resources are concentrated mostly in three states - Madhya Pradesh, Andhra Pradesh and Chhattisgarh.**

67. Solution: (b)

Exp) Option b is the correct answer.

The rare-earth elements (REE), also called the rare-earth metals or the lanthanides (though yttrium and scandium are usually included as rare-earths) are a set of 17 nearly-indistinguishable lustrous silvery-white soft heavy metals.

Statement 1 is incorrect. India imports rare earth metals not due to lack of its reserves. In fact, India is the **fifth largest reservoir of rare earth elements** in the world. But the real issue is that the Indian rare earth industry keeps on operating on the downstream production process only. The upstream process involves higher environmental risk and advanced **technology, which is lacking**. Hence, the imports are high.

Statement 2 is correct. Matsya 6000 is an **Indian manned deep-submergence vehicle under deep ocean mission** intended to be utilised for deep sea exploration of rare

minerals. Currently under development, the vehicle would consist a titanium-alloy sphere of 80mm thickness along with diameter of 2.1m which can withstand the pressure of 600 bar.

Statement 3 is incorrect. Rare earth elements not limited to the western coast of India. For example, **the states having resources of in situ monazite are Odisha, Andhra Pradesh, Tamil Nadu, Kerala, West Bengal, Jharkhand.**

The entire landmass and rocks around Indian Ocean Region (IOR) contain the REEs as the coastline is enriched with 'Mineral Sands', an easily recognizable black colour sand used as alloy, paint, filtration, and sandblasting. These mineral sands contain rare earth elements.

68. Solution: (a)

Exp) Option a is the correct answer.

Uranium and thorium are naturally occurring, radioactive heavy metals with unusual properties. The energy generated by the natural breakdown of radioactive elements is immense and can be used in nuclear reactors.

Statement 1 is correct. World's largest thorium reserves in the form of monazite are found in India **on the coast of Kerala**. The country's thorium reserves make up **25 per cent of the global reserves.** India's thorium deposits, estimated at 360,000 tonnes, far outweigh its natural uranium deposits at 70,000 tonnes. It can easily be used as a fuel to cut down on the import of Uranium from different countries

Statement 2 is incorrect. Australia possesses around 30% of the world's known recoverable uranium reserves. **Kazakhstan** contains about **13%** of the world's recoverable uranium, with 50 known deposits and around 20 operating uranium mines.

Statement 3 is incorrect. Much like uranium, thorium is also a fertile substance, but not a fissile substance by itself. It requires work to make it usable in a nuclear reactor. The process through which Thorium can be made usable in the reactor is a **three-stage process**. It starts with using Pressurized Heavy Water Reactors (PHWR) and light water reactors to convert natural uranium to plutonium. Next, the neutrons from plutonium breed U-233 from Thorium. The final stage, Advanced Heavy Water reactors burn U-233 with Thorium, and about 66 per cent of power is generated from Thorium fission.

69. Solution: (c)

Exp) Option c is the correct answer.

Coal bed methane (CBM), an important unconventional gas occurring naturally in coal beds, is Coal bed methane (CBM) is a form of natural gas which can be recovered from coal deposits or coal seams (a coal deposit is a geographical location containing mineable accumulations of coal while a coal seam is entrapment of coal in underlying rock).

Statement 1 is correct. The coal bed methane is formed during the natural conversion of plant material into coal, known as coalification. When coalification occurs, the coal becomes saturated with water and methane gas is trapped within it. CBM can be recovered from coal deposits and seams through drilling and extraction. The composition of CBM in a sample of coal varies widely across several locations. Generally, it consists predominantly of methane gas (CH4) although it can contain trace amounts of ethane (C2H6), carbon dioxide (CO2) and water (H2O).

Statement 2 is correct. Coal bed methane can be converted into other types of hydrocarbons like diesel and gasoline commonly used as fuel for automobiles.

Statement 3 is incorrect. CBM is a fossil fuel which releases CO2, a known greenhouse gas during combustion. Moreover, its main component, methane, offers up to 72 times more global warming potential (GWP) per unit mass than CO2.

Statement 4 is correct. The Gondwana sediments of eastern India host the bulk of India's coal reserves and all the current CBM producing blocks. India has the fifth largest proven coal reserves in the world and thus holds significant prospects for exploration and exploitation of CBM.

Important Tips

What Is Coal Bed Methane Used for?

Coal bed methane and its by-products are suitable for a host of industrial applications, notably:

Power Generation: It can be used in place of natural gas in gas turbines for power generation.

Manufacturing: CBM can also be used as a feedstock for manufacturing fertilizers and plastics.

Controversy Surrounding Coal Bed Methane Gas Production -

The controversy surrounding coal bed methane extraction has to do with the use of water during the process and its impact on global climate change. Coal bed methane exploration involves pumping large volumes of water **out of coal seams** to reduce the hydrostatic pressure and liberate the gas.

The produced water from coal bed methane wells has a fairly high salinity (due to dissolved sodium bicarbonate ions or chlorides) making it unsuitable for certain agricultural activities due to adverse and long-term chemical or physical effects on soil structure.

70. Solution: (d)

Exp) Option d is the correct answer.

A naturally occurring substance that has a definite chemical composition is a **mineral**.

The process of taking out minerals from rocks buried under the earth's surface is called **mining**.

Pair 1 is correct: Minerals that lie at shallow depths are taken out by removing the surface layer; this is known as **open-cast mining**. Iron ore, bauxite, **coal** and copper etc are mined in this way.

Pair 2 is correct: Often the minerals are not found close to the surface of the Earth, but deeper down. In these cases, underground mining, also called shaft mining, is used. **Examples of shaft mining used for minerals like**

diamonds, gold and sometimes the platinum group metals (PGM). Also Deep bores, called **shafts**, have to be made to reach mineral deposits that lie at great depths. This is called **shaft mining.** Petroleum and natural gas occur far below the earth's surface. Deep wells are bored to take them out.

Pair 3 is correct: Minerals that lie near the surface are simply dug out, by the process known as **quarrying. Marble, granite, and limestone are mined through quarries.** Quarrying material for use in building materials was much more work.

Imprtant Tips

Open-pit mining is also known as opencast mining, is a surface mining technique that extracts minerals from an open pit in the ground. Open-pit mining is the most common method used throughout the world for mineral mining and does not require extractive methods or tunnels.

Quarrying is the process of removing rock, sand, gravel or other minerals from the ground in order to use them to produce materials for construction or other uses. So, a quarry is any such working on the surface of the earth where minerals are extracted. Quarries are also known by other names around the world: 'surface mine', 'pit', 'open pit' or 'opencast mine'.

71. Solution: (a)

Exp) Option a is the correct answer.

Depending on the mode of occurrence and the nature of the ore, mining is of two types, and they are **opencast mining (also known as surface mining) and underground mining.** While underground mining is suitable for extracting deep mineral deposits, opencast mining is suitable for extracting shallow mineral deposits.

Statement 1 is correct: Opencast mining is generally cheaper due to less equipment and infrastructure needed, easier access to the resource, and less need for excavation and transportation. Conversely **underground mining is relatively costlier** due to higher infrastructure costs, ventilation, and safety measures etc.

Statement 2 is incorrect: Opencast mining typically has a higher output due to **faster extraction and the ability to use larger machinery.** On the other hand, underground mining typically involves lower output due to limitations in tunnel size and access, and a slower extraction process.

Statement 3 is incorrect: Both opencast and underground mining require land reclamation efforts to restore the environment after mining operations cease. However, due to its larger impact, opencast mining often faces greater challenges.

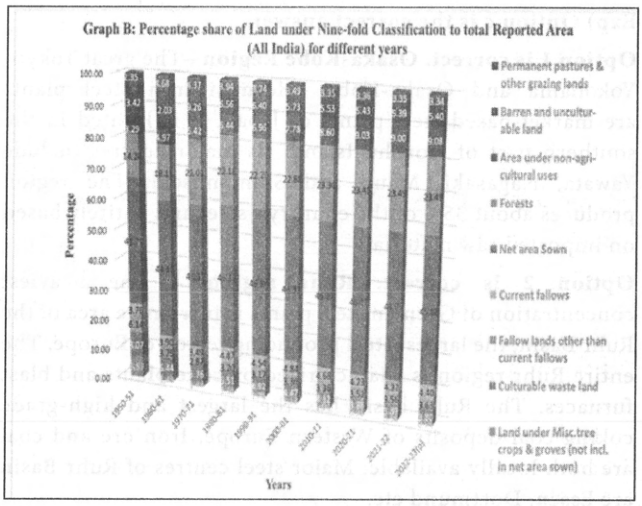
72. Solution: (d)

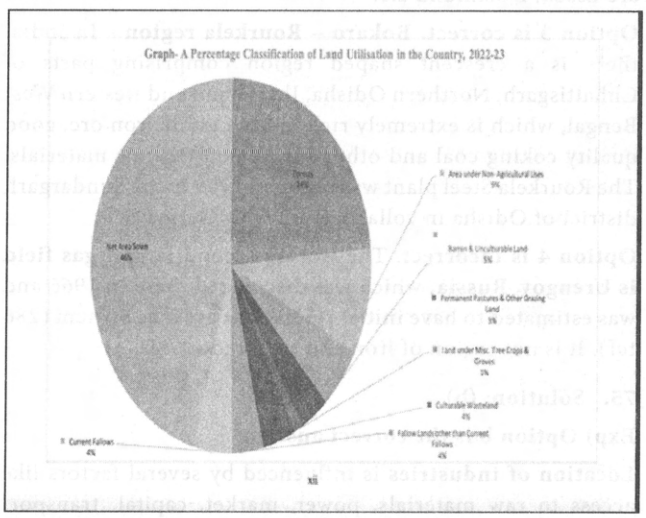
Exp) Option d is the correct answer.

Statement 1 is incorrect. Net Area Sown is the physical extent of land on which crops are sown and harvested. **Net Area Sown represents the total area sown with crops.** Areas **sowed more than once in the same year are counted only once.**

Gross Cropped Area represents the total area sown once and/or more than once in a particular year, i.e. **the area is counted as many times as there are sowings in a year.** This total area is also known as total cropped area or total area sown.

Statement 2 is incorrect. The net sown area has been decreasing since 1991. In 2022-23, the net sown area was 45.88% of India's total area. It was 46.84 in 1990-91.





6.2. Industry and Location Factors

73. Solution: (d)

Exp) Option d is the correct answer.

Pair 1 is incorrect: The Lancashire region is an industrial region in the **United Kingdom (not in the United States of America)**, located in the northwest of England. It is known for its textile industry, especially cotton and wool, as well as its coal mining and engineering sectors.

Pair 2 is incorrect: The Southern Appalachian region is an industrial region in the **United States of America (not in Switzerland),** spanning parts of several states from Virginia to Alabama. It is rich in natural resources, especially coal and timber, and has a diverse range of industries, such as textiles, furniture, paper, and electronics.

Pair 3 is incorrect: The Keihin region is an industrial region in **Japan (not in Germany)**, consisting of the cities of Tokyo, Kawasaki, and Yokohama. It is one of the most densely populated and economically dynamic regions in the world, with a large concentration of manufacturing, trade, and service industries.

74. Solution: (c)

Exp) Option c is the correct answer.

Option 1 is correct. Osaka-Kobe Region –The great Tokyo-Yokohama and Osaka-Kobe –Heemeji iron steel plants are market-based steel plants of Japan. It is located in the southern part of Honshu Island. Its major centres include Yawata, Nagasaki, Mauji and Shimonoseki. The region produces about 35% of the country's steel and entirely based on imported raw material.

Option 2 is correct. Ruhr region – The heaviest concentration of German steel plants is in a single area of the Ruhr Basin, the largest steel producing region of Europe. The entire Ruhr region is characterized by coke plants and blast furnaces. The Ruhr basin has the largest and high-grade coking coal deposits of Western Europe. Iron ore and coal are both locally available. Major steel centres of Ruhr Basin are Essen, Dortmund etc.

Option 3 is correct. Bokaro – Rourkela region - In India, there is a crescent shaped region comprising parts of Chhattisgarh, Northern Odisha, Jharkhand and western West Bengal, which is extremely rich in high grade iron ore, good quality coking coal and other supplementing raw materials. The Rourkela Steel plant was set up in 1959 in the Sundargarh district of Odisha in collaboration with Germany.

Option 4 is incorrect. The world's second largest **gas field is Urengoy, Russia,** which was discovered there in 1966 and was estimated to have initial reserves as great as 8.1 tcm (286 tcf). It is not region of iron and steel industries.

75. Solution: (b)

Exp) Option b is the correct answer.

Location of industries is influenced by several factors like access to raw materials, power, market, capital, transport and labour, etc. There is strong relationship between raw material and type of industry. It is economical to locate the manufacturing industries at a place where cost of production and delivery cost of manufactured goods to consumers are the least. Industries using weight-losing raw materials are located in the regions where raw materials are located.

Option 1 is correct. The sugar mills in India are located in sugarcane growing areas. Sugar industry in India is based on sugarcane which is a heavy, low value, weight losing and perishable raw material. Also the sugarcane contains sucrose and once you cut the sugarcane, the sucrose content starts to decline.

Option 2 is correct. Wood is the primary raw material for this industry, it is a weight losing raw material. Pulp mills must be located near the forests because this minimises the difficulty of transporting the bulk logs as well as cost also.

Option 3 is correct. In iron and steel industries, iron ore and coal both are weight-losing raw materials. Therefore, an optimum location for iron and steel industries should be near raw material sources.

Option 4 is correct. Copper smelting industries are located near raw material sources as it is a weight losing industry. Location near raw materials helps to reduce cost of transportation.

Option 5 is incorrect. Cotton is a "pure" raw material which **does not lose weight** in the manufacturing process. so other factors, like, power to drive the looms, labour, capital or market may determine the location of the industry. Hence this option is incorrect.

76. Solution: (b)

Exp) Option b is the correct answer

Presently, India has 22 operating reactors, with an installed capacity of 6780 MWe. Among these eighteen reactors are Pressurised Heavy Water Reactors (PHWRs) and four are Light Water Reactors (LWRs).

Pair 1 is incorrect: Rawatbhata Nuclear Power Plant is located near the town of Rawatbhata in the **Chittorgarh district of Rajasthan, India.** The plant has a total installed capacity of 1,180 MW, with six heavy water reactors in operation.

Pair 2 is incorrect: Kaiga Nuclear Power Plant is situated near the village of Kaiga, in the Uttara Kannada district of Karnataka, India. The plant has four operational pressurized heavy water reactors with a combined capacity of 880 MW.

Pair 3 is correct: Kakrapar Nuclear Power Plant is located in the state of Gujarat, near the city of Surat, India. The plant consists of two pressurized heavy water reactors with a total capacity of 1,400 MW.

Pair 4 is correct: Kalpakkam Nuclear Power Plant is located in the Kancheepuram district of Tamil Nadu, near the town of Kalpakkam, India. The plant has two pressurized heavy water reactors with a combined capacity of 470 MW and is also home to the Fast Breeder Test Reactor (FBTR).

77. Solution: (c)

Exp) Option c is the correct answer.

Fertilizers have played an essential role in agricultural production, providing vital nutrients for crops and registering increasing demands over the years. As an agrarian country, India is home to numerous small and marginal farmers and is often plagued by low productivity and low quality. Crops are mainly rainfed and cultivated on single piece of land over time, decreasing soil fertility in many regions. Thereby, increasing quantities of nitrogen fertilizers have been used in the country.

Statement 1 is correct. Urea/ Nitrogen Based industries are located near Natural gas source Natural Gas has Methane (CH_4), which when mixed with Oxygen, Nitrogen + heat in presence of catalysts produces Ammonia (NH_3), known as Haber process .This Ammonia (NH_3) can be used for making nitrogen-based fertilizers e.g. Urea. Therefore availability

(and price) of Natural Gas, affects the location of Fertilizer industry.

Statement 2 is correct. Rock Phosphate is the key raw material for DAP and NPK fertilizers and India is 90% dependent on imports of it.

78. Solution: (d)

Exp) Option d is the correct answer.

Option 1 is incorrect: Gurgaon-Delhi-Meerut Region is located far away from the mineral and power resources, and therefore, the industries are **light and market-oriented.** Electronics, light engineering and electrical goods are major industries of this region.

Option 2 is incorrect: Bangalore-Chennai Industrial Region is located **far away from the coalfields.** Industries in this region faces thermal power shortage and it is relying on other sources such as Hydroelectricity, Nuclear energy, Solar and Wind energy to bridge the gap. Aircraft (HAL), machine tools, telephone (HTL) and Bharat Electronics are industrial landmarks of this region.

Option 3 is correct: Chotanagpur Region owes its development to its **location near the sources of coal, iron ore and other minerals. This facilitated** the location of heavy industries in this region. Six large integrated iron and steel plants at **Jamshedpur, BurnpurKulti, Durgapur, Bokaro and Rourkela** are located within this region.

Option 4 is correct: The development of Gujarat Industrial Region is associated with the location of the cotton textile industry since the 1860s. **Located in cotton growing area, this region has double advantage of the proximity of raw materials as well as of the market.**

79. Solution: (c)

Exp) Option c is the correct answer.

Production involves the process of alteration of resources and/or value addition over goods produced. It takes place in five sectors of the economy viz a viz **primary, secondary, tertiary, quaternary and quinary.**

Option a is incorrect: Secondary activities involve manufacturing processes and construction (infrastructure) industries. It is concerned with transforming raw materials into valuable products, e.g., conversion of iron ore into steel, making yarn out of cotton, etc.

Option b is incorrect: Quaternary activities involve **the collection, production and dissemination of information.** Quaternary activities centre around **research, development** and may be seen as an advanced form of services. **Tax consultants, software developers and statisticians,** accounting and brokerage firms all belong to this category of service.

Option c is correct: Quinary activities are services that focus on the **creation, re-arrangement and interpretation of new and existing ideas;** data interpretation and the use and evaluation of new technologies. They represent special and **highly paid skills of senior business executives,** government officials, research scientists, **financial and legal consultants, etc.**

Option d is incorrect: A primary economic activity refers to an economic activity that involves collecting, extracting or harvesting natural resources. The goods produced through a primary economic activity can either be consumed directly or can be used as a raw material to produce or manufacture a different product.

80. Solution: (a)

Exp) Option a is the correct answer.

India is the second largest producer of nitrogenous fertilisers in the world. India is the **3rd largest producer of phosphatic fertilisers** however India meets its entire **potash requirement through imports** because of the limited resources.

Statement 1 is correct: Indian Farmers Fertiliser Cooperative Limited **(IFFCO) has developed nanotechnology-based Nano Urea (Liquid) fertilizers. IFFCO's Nano Urea is the only Nano fertilizer approved by the Government of India.** It is Patented by IFFCO and application of 1 bottle of Nano Urea can effectively replace at least 1 bag of Urea.

Statement 2 is correct: Fertiliser industries are located near the source of raw materials. Naphtha is the most important raw material for manufacturing fertilisers. **Naphtha** is derived from **petroleum;** hence many fertiliser industries are **located near oil refineries.**

Statement 3 is incorrect: India, the **top importer of urea, imports about 30%** of its average annual consumption of the Urea. It means more than **2/3rd of India's urea needs is met through her domestic production.**

81. Solution: (b)

Exp) Option b is the correct answer.

The Steel Authority of India Limited (SAIL) has **five integrated steel plants** at **Bhilai** (Chhattisgarh), **Rourkela** (Odisha), **Durgapur** (West Bengal), **Bokaro** (Jharkhand) and **Burnpur** (West Bengal). It also has **three special and alloy steels plants** viz. Alloy Steels Plant at Durgapur (West Bengal), Salem Steel Plant at Salem (Tamil Nadu) and **Visveswaraya Iron and Steel Plant at Bhadravati** (Karnataka).

Pair 1 is incorrect: Visvesvaraya Iron and Steel Plant (VISL) is a pioneer in production of high quality alloy & special steels and pig iron. It is located in **Bhadravati, Karnataka.** Initially, it was called the **Mysore Iron and Steel Works.** It is located close to an iron ore producing area of Kemangundi in the Bababudan hills. **The Bhadravati River** supplies water to the plant. This plant produces specialised steels and alloys.

Pair 2 is correct. The **Rourkela Steel plant** is **an integrated steel plant** located in the **Sundargarh district of Odisha.** It was set up in 1959 in collaboration with Germany. The plant was located on the basis of proximity to raw materials, thus, minimising the cost of transporting weight losing raw material. This plant has a **unique locational advantage,** as it receives coal from Jharia (Jharkhand) and iron ore from **Sundargarh** and **Kendujhar. The Hirakud project** supplies power for the electric furnaces and water is obtained from the **Koel** and **Sankh rivers.**

Pair 3 is correct. Durgapur Steel Plant is an **integrated Steel Plant** in **West Bengal.** It was set up in collaboration with the government of the United Kingdom. It started production in 1962. This plant lies in **Raniganj** and **Jharia coal belt** and gets iron ore from **Noamundi.** It on the main **Kolkata-Delhi railway route.** The Hydel power and water is obtained from the **Damodar Valley Corporation** (DVC) by this plant.

82. Solution: (a)

Exp) Option a is the correct answer.

Statement I is correct- Railway gauges refer to the **distance between the inner edges of the two rails that make up a railway track.** There are four main types of railway track gauges - **Meter Gauge, Broad Gauge, Standard Gauge** and **Narrow Gauge.** In hilly areas with difficult terrain, **narrow gauge railway tracks are preferred over other types of railway track gauge.**

Statement-II is correct and Statement-II is the correct explanation for Statement-I- Narrow gauge tracks have a **smaller radius of curvature than standard gauge tracks,** allowing them to **navigate tighter bends and corners.** This is crucial in **hilly terrain** where the **track needs to follow the contours of the landscape without extensive earthworks or tunnelling.** Some other advantages include **lower construction costs, improved maneuverability, and suitability for challenging terrain.**

83. Solution: (b)

Exp) Option b is the correct answer.

Basic industries are those that **supply raw materials** and **energy sources** for the production of other goods. They can be classified based on the **type and source of raw materials.** Some examples of basic industries, such as **Iron and steel, Copper smelting, Aluminum smelting, Power plants, and Transportation,** are responsible for producing commodities like **Oil, Steel, Chemicals, Natural gas, and Electricity.**

84. Solution: (c)

Exp) Option c is the correct answer.

A **footloose industry** is a broad term referring to an industry that can be situated in **diverse locations with minimal impact** from factors such as **raw materials.** The term "footloose" is apt as these industries are **susceptible to relocation.** For instance, examples of footloose industries include **diamond and computer chip manufacturing.**

Statement 1 is correct- Footloose industry is a general term for an industry that can be placed and **located at any location without much effect from factors of production** such as resources, land, and labour. Unlike resource-based industries, footloose industries **don't require bulky or location-specific raw materials.** They often rely on **processed materials, components, or information,** which can be readily transported to different locations. For example, **a software development company doesn't need to be located near a specific resource;** it can **operate anywhere with reliable internet access and skilled personnel.**

Statement 2 is correct - Footloose industries are considered **environmentally friendly,** given that their processes result in a **minimal carbon footprint,** emitting little to no pollution.

Statement 3 is correct: The diamond processing industry and **computer chips industry** are some examples of footloose industries

85. Solution: (a)

Exp) Option a is the correct answer

Jute Textile Industry is one of the major Industries in the Eastern India, particularly in West Bengal. This is the second important textile industry after cotton textile. Features of the jute industries are:

Statement 1 is incorrect - Jute manufacturing existed as a handloom industry but the large-scale industry started in 1855 in Rishra near Calcutta. **The partition of the country in 1947 created a peculiar problem for jute industry. Almost all mills remained in India but 80% of jute producing area went to erstwhile East Pakistan.** The import of raw material from East Pakistan was cut off due to the political differences between the two countries.

Statement 2 is incorrect - India is the world's biggest producer of jute, followed by Bangladesh. **Jute is primarily grown in West Bengal, Odisha, Assam, Meghalaya, Tripura and Andhra Pradesh.**

Statement 3 is correct – Jute industry is traditionally in an export-oriented industry and **its survival largely depends upon its export performance.** The rise and fall of the industry is closely linked with the demand for goods in the international and national markets.

86. Solution: (a)

Exp) Option a is the correct answer.

The fertilizer industry in India is a vital sector that produces and supplies essential nutrients for crop growth and development. The industry manufactures nitrogenous, phosphatic and complex fertilizers, and organic manure.

Statement 1 is correct: Most of the urea fertilizer industries of India are **located near oil refineries because they use naphtha as the basic raw material** for producing nitrogenous fertilizers. For example, the Gujarat-Maharashtra region has fertilizer plants at Hazira, Mumbai, Trombay, Vadodara, etc., which are close to oil refineries.

Statement 2 is incorrect: India meets **less than half of its domestic demand for urea** through imports. India imports about 30% of urea annually from countries such as Oman, Qatar, Saudi Arabia and the UAE. India spent $5.1 billion to import 8.1 million Tonnes urea in 2022-23 (April-January) against 10.2 million Tonnes at $6.5 billion in FY22.

Statement 3 is incorrect: Fertilizers **are not exempted from the regime of Goods and Services Tax** (GST). They are **subject to 5% GST,** except for those which are clearly not to be used as fertilizers, which attract 18% GST. The GST rate on fertilizers was increased from the previous 4-8% rates, depending on raw materials used and in which states the products were sold.

87. Solution: (c)

Exp) Option c is the correct answer.

Ports play a vital role in the overall economic development of India. They account for about 95% by volume and 70% of the value of the country's international trade.

Pair 1 is correctly matched: Jawaharlal Nehru Port at Nhava Sheva was developed as a satellite port to relieve the pressure at the Mumbai port. It is the largest container port in India. The Jawaharlal Nehru Port Authority (JNPA) at Navi Mumbai is a premier container handling Port in India accounting for around 50% of the total containerized cargo volume, across the major ports of India.

Pair 2 is correctly matched: Mumbai, the largest port in India, is a natural harbor strategically located along the general routes connecting the Middle East, Mediterranean countries, North Africa, North America, and Europe. With dimensions of 20 km length and 6-10 km width, it features 54 berths and hosts the nation's largest oil terminal. The port's primary hinterlands include M.P., Maharashtra, Gujarat, U.P., and parts of Rajasthan.

Pair 3 is correctly matched: Kolkata Port is the only riverine Major Port of India. It has been recently named Syama Prasad Mookerjee Port. Haldia Port, located at the mouth of the Hugli River eases the pressure on Kolkata Port which is also located on the same river.

Important Tips

Indian Ports are broadly classified as Major Ports and Non-Major Ports. The Major Ports are under the administrative control of Government of India while the non-major ports are governed by the respective states.

88. Solution: (a)

Exp) Option a is the correct answer.

India is rich in mineral resources, and the country is endowed with a diverse range of minerals, both metallic and non-metallic.

Petroleum or mineral oil stands as a significant energy source in India. It serves various purposes, including providing fuel for heat and lighting, lubricants for machinery, and raw materials for several manufacturing industries. Petroleum refineries play a crucial role as a "nodal industry" for synthetic textiles, fertilizers, and numerous chemical sectors.

Petroleum is present in fault traps formed between porous and non-porous rocks, with gas typically occurring above the oil due to its lighter nature. Key petroleum production areas in India include **Mumbai High, Gujarat, and Assam. Ankeleshwar is a significant field in Gujarat, and Assam, the oldest oil-producing state, has important fields like Digboi, Naharkatiya, and Moran-Hugrijan.**

89. Solution: (d)

Exp) Option d is the correct answer.

Pair 1 is correctly matched: Detroit is a major automobile manufacturing area of the USA. It is also called 'Motor City' due to its historical significance in the automobile industry. The city continues to host major automotive companies such as General Motors, Ford, and Stellantis.

Pair 2 is correctly matched: The Orinoco Basin, which is in Venezuela, is renowned for its extensive **oil producing capabilities.** It holds one of the largest oil reserves globally, primarily in the form of heavy crude oil embedded in the region's vast oil sands.

Pair 3 is correctly matched: Kryvyi Rih which is in Ukraine, is primarily known for its iron ore mining and metallurgical industries. The city is a significant center for iron and steel production.

Pair 4 is correctly matched: Chuquicamata, which located in Chile, is known for Copper Production. It is one of the world's largest open-pit copper mines and a significant producer of copper.

90. Solution: (d)

Exp) Option d is the correct answer.

Thermal power plants are the largest industrial consumers of water in India. They use water mainly for cooling, steam generation, and ash handling. According to the **The Energy and Resources Institute** (TERI), thermal power plants account for a massive **87.87% of total industrial water consumption,** far exceeding any other sector. The sheer scale of power generation operations and the need for continuous cooling in power plants contribute to their dominance in water usage. This sector's high water consumption makes it a critical area for water conservation.

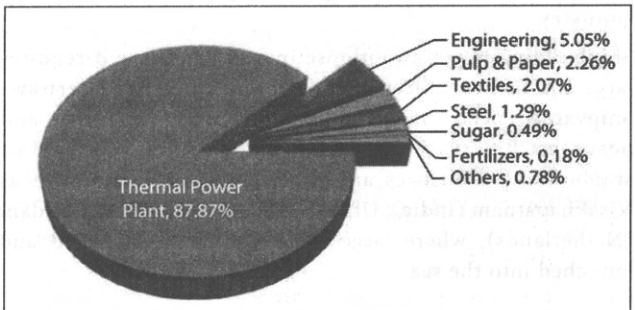


Figure 1a. Water consumption in Indian industries[2]

91. Solution: (b)

Exp) Option b is the correct answer.

Footloose industries are industries that are not dependent on specific raw materials or geographical location. They can be established in any region with suitable infrastructure, skilled labor, and good connectivity. These industries typically deal with lightweight, high-value products and rely more on technology and human expertise rather than proximity to natural resources. These are generally non-polluting industries

Option 1 is correct: Diamond Cutting – Footloose Industry

Diamond cutting and polishing is a footloose industry because it does not require the raw materials (diamonds) to be sourced locally. Instead, uncut diamonds are imported from mining countries and processed in hubs with skilled

labor. For example, Surat in India is a global center for diamond cutting despite not having diamond mines.

Option 2 is correct: Semiconductor Manufacturing – Footloose Industry

Semiconductor manufacturing is a footloose industry as it is not dependent on any specific geographical location or natural resources. While it requires silicon (which is commonly available), the primary factors influencing its location are skilled labor, high-end technology, research facilities, and government incentives. Countries like the USA (Silicon Valley), Taiwan, and South Korea are leaders in semiconductor production, even though they do not have major silicon reserves.

Option 3 is correct: Pharmaceuticals – Footloose Industry

The pharmaceutical industry is footloose because its production depends on scientific research, skilled professionals, and regulatory compliance rather than the availability of raw materials. While raw ingredients for medicines are required, they are lightweight and easily transportable, making location less important.

Option 4 is incorrect: Cotton Textiles – Not a Footloose Industry

The cotton textile industry is not a footloose industry because it relies heavily on the availability of cotton. Textile factories are often located near cotton-growing regions and areas with access to cheap labour and water supply.

Option 5 is incorrect: Shipbuilding – Not a Footloose Industry

Shipbuilding is not a footloose industry because it requires large coastal areas, deep harbours, and access to waterways. Shipyards need massive infrastructure, cranes, and heavy machinery, which cannot be easily relocated. Most shipbuilding industries are situated in port cities such as Visakhapatnam (India), Ulsan (South Korea), and Rotterdam (Netherlands), where large ships can be constructed and launched into the sea

92. Solution: (c)

Exp) Option c is the correct answer.

Under the National Waterways Act, 2016, 111 waterways (including 5 existing and 106 new) spread over 24 States have been declared National Waterways (NWs) for development of Inland Water Transport (IWT) in the country. The advantages of Inland Waterways in India are:

Option 1 is correct: Inland water transport (IWT) is considerably cheaper than road and rail transport. It is reported to be 60% cheaper than road transport and 20-30% cheaper than rail.

Option 2 is incorrect: Inland waterways are typically slower than road transport, especially for time-sensitive goods. Speed efficiency is not an advantage of waterways.

Option 3 is correct: Inland water transport (IWT) emits 10 times less carbon dioxide per ton-kilometer compared to road transport, contributing to lower greenhouse gas emissions.

Option 4 is correct: Utilization of waterways minimizes the need for extensive land acquisition. Land acquisition is often a contentious and time-consuming process associated with road and rail projects. Inland waterways require less land acquisition compared to road infrastructure projects, which is an advantage over road transport.

93. Solution: (a)

Exp) Option a is the correct answer.

Row 1 is incorrectly matched: The Deendayal Port is located on the **Gulf of Kutch in Gujarat on the northwestern coast of India**. It was the **largest port of India by volume of cargo handled till 2022-23 for a long period of time but has been surpassed by the Paradeep Port of Odisha** as the highest cargo handling major port of the country **in 2023-24.**

Paradip Port Authority (PPA's) remarkable journey has reached new heights with the recent record-breaking achievement of clocking incredible 145.38 MMT cargo throughput in FY 2023-24 and thus-by nudged passed Deendayal Port, Kandla to emerge as the highest cargo handling major port of the country. For the first time in the 56 years history of operation, PPA has surpassed previous records, set by Deendayal Port. Paradip Port has also recorded growth of 10.02 million metric tonnes (7.4%) of traffic on YoY basis.

Row 2 is correctly matched: JNPT continues to be the leading container handling port in the country with a share of 44.7% in terms of tonnage and 53.7% in terms of TEUs in the total container traffic at major ports during 2022-23 followed by Chennai Port (16.7%), V.O. Chidambaranar Port (8.6%), Kamarajar (6. 2%), Cochin Port (5.9%), SMP Kolkata Dockyard System, Deendayal Port and Visakhapatnam Port (5.0%) each New Mangalore (1.4%) and SMP Haldia (1.2%) in terms of tonnes during 2022-23.

Row 3 is incorrectly matched: Kamarajar Port, **located on the Coromandel Coast about 24 km north of Chennai Port, Chennai, Tamil Nadu (not Kerala)** it is the 12th major port of India, and the first port in India which is a public company. The port was declared as a major port under the Indian Ports Act, 1908 in March 1999 and incorporated as Ennore Port Limited under the Companies Act, 1956 in October 1999. The **Kamarajar Port is the only corporatized major port and is registered as a company.**

Mundra Port of Gujarat is the largest Privately owned port of India.

94. Solution: (a)

Exp) Option a is the correct answer.

The oceans provide a vast, maintenance-free highway, navigable in all directions. The evolution of sea routes has been a significant milestone in human adaptation to the physical environment.

One of the most crucial maritime routes is the **Northern Atlantic Sea Route, linking the industrial powerhouses of North-eastern U.S.A. and North-western Europe.** This route handles one-fourth of global foreign trade, surpassing

the combined trade volume of all other sea routes. **Due to its immense economic significance and heavy traffic, it is often referred to as the "Big Trunk Route."**

95. Solution: (b)

Exp) Option b is the correct answer.

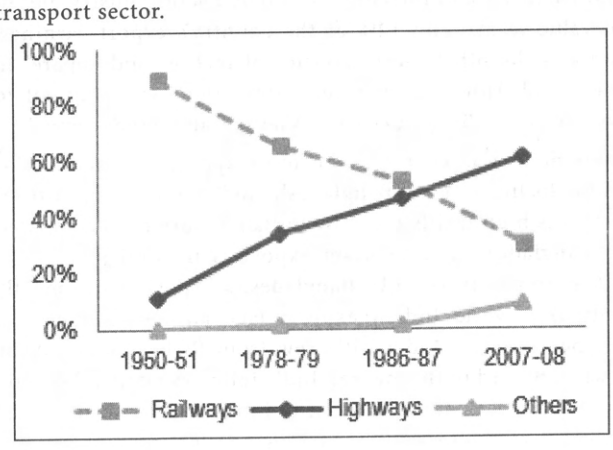
Indian Railways is a government-owned-railway system under the ownership of Ministry of Railways, Government of India that operates India's national railway system. It manages the Fourth-largest railway network in the world by size, with a route length of 67,956 km as of 31 March 2020.

Statement 1 is correct. Railways has been losing out on the FMCG and automobile markets (which are preferring roads) due to absence of last mile linkages.

Statement 2 is correct. The share of Indian Railways in freight movement **has been witnessing a drop over a period of time, mainly on account of non-competitive tariff structure.** Railways' freight rates are already higher than other modes of transport for several commodities.

Statement 3 is correct. Railways' operating ratio has consistently been higher than 90% in the past several years, which indicates that its **capability to generate operational surplus** is low. Further, its expenditure on staff and pension has been increasing. Consequently, capacity growth is increasingly being funded through borrowings.

Statements 4 is incorrect. Facing stiff competition from other modes of transportation, the government is introducing various transformative measures in order to keep railways on track. These measures include new modernised wagons, dedicated freight corridors, high speed rail, high-capacity rolling stock, port connectivity, and attracting private and foreign direct investment. The FDI Policy permits 100% FDI in the railway's infrastructure sector. FDI is permitted in the construction, operation and maintenance of the railway transport sector.



Industry and Location Factors

96. Solution: (d)

Exp) Option d is the correct answer.

Japan is an island nation with a population of 128 million, a land area of 377 801 km^2, a coastline of 29 751 km, and an EEZ of approximately 4.05 million km^2, the sixth largest in the world and about twelve times larger than the national land area.

Statements 1, 2 and 3 are correct.

A combination of warm (Kuroshio) and cold (Oyashio) currents flows along the coasts, creating one of the most abundant fishing grounds in the world.

Other reasons for growth of fishing industry in Japan include:

(i) Japan has a large population which provides ready local market for fish.

(ii) Japanese have a long history of sea faring thus are highly experienced in fishing.

(iii) The shallow continental shelf allows light to the sea bed for growth of micro-organisms which are food for fish.

(iv) Japan has developed unique marketing and distribution system of fish and fishery products to meet domestic demand and earn revenue from fisheries export.

(v) Japan is also not endowed with natural resources, for as much as 80% of the land is not suitable for agriculture. Thus, it heavily depends on the sea to survive.

97. Solution: (d)

Exp) Option d is the correct answer.

The world's major industries are the iron and steel industry, the textile industry and the information technology industry. The iron and steel and textile industry are the older industries while information technology is an emerging industry.

Pair 1 is correct. The countries in which iron and steel industry is located are Germany, USA, China, Japan and Russia. Other main producers of iron and steel in the world are South Korea, Brazil, Ukraine, India, France, Italy and Great Britain, South Africa, Australia, Austria, Netherlands, Czech Republic, Romania, Spain, Belgium, Sweden, etc.

Pair 2 is correct. Textile industry is concentrated in India, Hong Kong, South Korea, Japan and Taiwan. The leading producers of cotton cloth in the world are China, India, Russia, USA, Japan, Italy, Germany, Hong Kong, Egypt, France and Romania.

Pair 3 is correct. The major hubs of Information technology industry are the Silicon Valley of Central California and the Bangalore region of India. **Silicon Valley** is a region in Northern California that serves as a global center for high technology and innovation. Located in the southern part of the San Francisco Bay Area, it corresponds roughly to the geographical Santa Clara Valley. San Jose is Silicon Valley's largest city,

98. Solution: (a)

Exp) Option a is the correct answer.

Products that are classified under the FMCG banner include **food, beverages, personal hygiene and household cleaning utensils**. The term "fast- moving" stems from the fact that FMCG products usually have a short shelf life and are non-durable.

Fast moving consumer goods (FMCG) are the 4th largest sector in the Indian economy.

Statement 1 is correct. There are three main segments in the sector – **food and beverages (19%), healthcare (31%)** and **household & personal care (remaining 50%)**.

Statement 2 is correct. The **urban segment is the largest contributor** (accounts for a revenue share of around 55%) to the overall revenue generated by the FMCG sector in India.

However, in the last few years, the FMCG market has grown at a faster pace in rural India compared with urban India. Semi-urban and rural segments are growing at a rapid pace and FMCG products account for 50% of the total rural spending.

Statement 3 is incorrect. Government gave approval of 100% Foreign Direct Investment (FDI) in the cash and carry segment and in single-brand retail along with **51% FDI (and not 100%) in multi-brand retail for FMCG sector.**

100% FDI allowed in food processing segment.

99. Solution: (b)

Exp) Option b is the correct answer.

The quaternary sector or quaternary industry is the economic activity based on the intellectual or knowledge-based economy.

Option b is correct. It includes work that conceives, creates, interprets, organizes, directs and transmits with the help and support of scientific and technical knowledge. For example, mutual fund managers, **tax consultants, software developers**, statisticians, **academic researcher**, financial analyst, web developer etc.The foundation of this type of activity is creation. It is the sector of mind, knowledge, and skill. It creates value for the society from technology applications or human ingenuity.

Important Tips

- The main difference between the tertiary sector and the quaternary sector is that, although both provide services, the services of quaternary activities are intellectual rather than repetitive activities. Teachers, **lawyers, physicians,** musicians are the activities included in the Tertiary sector.
- Quinary sector involves the highest level of decision makers. These include Highly paid skills of senior executives, **government officials**, research scientists, financial and legal consultants.

100. Solution: (d)

Exp) Option d is the correct answer.

An oil refinery or petroleum refinery is an industrial process plant where petroleum (crude oil) is transformed and refined into useful products such as gasoline (petrol), diesel fuel, asphalt base, fuel oils, heating oil, kerosene, liquefied petroleum gas and petroleum naphtha.

Statement 1 is correct. In petroleum refineries, there is a huge demand of **skilled labours and other labours for welding, scaffolding, clamping, unplugging of certain lines, mechanical support for machines and motors** and lot more. So, access to labour supply is an important factor responsible for setting up of petroleum refineries.

Statement 2 is correct. Many oil refineries are located on the oil fields themselves. For refineries based on fields in such countries the greatest advantage is the proximity of the crude oil. Transport costs are saved and refining can begin as soon as the oil is brought to the surface. However, it is not essential that these refineries should be located near oil producing areas.

Statement 3 is correct. Refineries must also be **near large bodies of water or ports**, due to the large amount of water necessary used to process oil, especially in the **purification and cooling processes,** and for pipeline and cargo deliveries by way of ship. Half of the crude oil that refineries in California receive is imported from Alaska or foreign countries by way of water, which is why many refineries in California are located in the Bay Area

Statement 4 is correct. The climate of the region also plays important role in setting up of oil refineries. Plunging temperatures can result in many different malfunctions in a refinery that might require a shutdown, such as **flaring issues, flow control equipment failure, or frozen product within the piping system**. Steam and heat are essential in almost every refinery process. For example, crude oil needs to be kept **warm or else it will thicken and clog up the piping**. When temperatures get too low, it may be impossible for the refinery to keep the crude and other liquids flowing efficiently.

101. Solution: (a)

Exp) Option a is the correct answer.

India is among the world's largest producers of Textiles and Apparel. The domestic apparel & textile industry in India contributes 5% to the country's GDP, 7% of industry output in value terms, and 12% of the country's export earnings. India is the 6th largest exporter of textiles and apparel in the world. However, in recent times India is losing out to countries like Bangladesh and Vietnam in textiles sector.

Statement a is correct. The most appropriate reason for India losing out to Bangladesh and Vietnam in textiles sector is high tariffs faced by Indian exporters as compared to Bangladesh and Vietnam exporters in foreign markets. For example, in the EU, Bangladesh's exports enter mostly duty free while Indian exports face an average tariff of 9.2 per cent. As India withdrew from RCEP, India will be disadvantaged in the market. India industry's dependence on duty drawbacks at the expense of innovation are causing the textile industry to lose out to Bangladesh.

Statement b is incorrect. It is not the case that no subsidy is provided to the Indian textile industries to increase employment. Under, Pradhan Mantri Rojgar Protsahan Yojana (PMRPY), Government is paying the **8.33% contribution of employers to the Employee Pension Scheme (EPS)** in respect of new employees having a UAN. For the textile (apparel) sector, the Government will also be paying

the 3.67% Employees Provident Fund (EPF) contribution of the eligible employer for these new employees.

Statement c is incorrect. The world demand is increasingly shifting toward clothing based on man-made fibres while **Indian domestic tax policy favours cotton-based production** and the tariff policy shields an inefficient man-made fibre sector.

Statement d is incorrect. India's GSP (Generalised system of preferences) benefits were terminated by US in 2019 but this is not the appropriate reason for losing out to Bangladesh and Vietnam in textiles sector as the Generalised System of Preferences (GSP) facility for Bangladesh was suspended in June 2013.

102. Solution: (d)

Exp) Option d is the correct answer.

The Indian steel industry was delicensed and de-controlled in 1991 and 1992 respectively.

Statement 1 is correct. In 2019, India became the 2nd largest steel producer in the world after China and the largest producer of sponge iron in the world. The demand of raw material for Iron-steel industry in India, i.e., iron ore for Indian Steel Industry is met from the domestic supply in the country while the demand of coking coal is met mainly through imports.

Statement 2 is correct. Steel compared to other materials of its type has **low production costs**. The cost efficiency, recyclability, safety advantages and mass-reducing possibilities of steel is what makes it much better than other materials. In comparison to steel, aluminium costs as much as **60% more** when used in automotive production. In **raw materials costs**, aluminium is about three times more expensive than steel, while in terms of conversion costs it is about twice as expensive.

Statement 3 is correct. India has **second** highest crude steel production in world with 111.2mnT of steel production after China.

103. Solution: (d)

Exp) Option d is the correct answer.

The cotton sector in India is considered the second most developed sector in the textile industry (after man-made fibres). At 18% of the global total, India is the world's largest producer of cotton.

Statement 1 is correct. The availability of **reliable and cheap financial facilities** and services has played an important part in the gone past in determining the location of industries. The Cotton textile mills were set up at **Kanpur** based on **local investment.**

Statement 2 is correct. The **development of hydro-electricity** also favoured the location of the cotton textile mills away from the cotton producing areas. The rapid development of this industry in **Tamil Nadu** is the result of the **abundant availability** of **hydel power** for the mills. As power is the most essential input to run the industries hence, no industry can do without the supply of **regular good-quality energy**.

Statement 3 is correct. Apart from the availability of cheap low-wage labour, the **labour relations** is also a vital factor for setting up of any industry at any particular location and their smooth functioning. The regions, which are marked by the **presence of strong trade unions** and where the governments have been silent spectators towards the unlawful activities of the trade unions, those regions are generally given a **low priority** for setting up any industry.

6.3. Population

104. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect. Enlargement of urban centers and emergence of new towns have played a significant role in the growth of urban population and urbanization in the country. But the growth rate of urbanization has slowed down from 1981 onwards. Decennial growth rate of urbanization in 1981 was 46. 14%, in 1991-36.47%, in 2001-31.13%, in 2011-31.08. Thus, it has decreased.

Table 4.1 : India – Trends of Urbanisation 1901-2011

Year	Number of Towns/UAs	Urban Population (in Thousands)	% of Total Population	Decennial Growth (%)
1901	1,827	25,851.9	10.84	—
1911	1,815	25,941.6	10.29	0.35
1921	1,949	28,086.2	11.18	8.27
1931	2,072	33,456.0	11.99	19.12
1941	2,250	44,153.3	13.86	31.97
1951	2,843	62,443.7	17.29	41.42
1961	2,365	78,936.6	17.97	26.41
1971	2,590	1,09,114	19.91	38.23
1981	3,378	1,59,463	23.34	46.14
1991	4,689	2,17,611	25.71	36.47
2001	5,161	2,85,355	27.78	31.13
2011*	6,171	3,77,000	31.16	31.08

*Source: Census of India, 2011 http://www.censusindia.gov.in (Provisional)

Statement 2 is incorrect. Among States, Goa is the most urbanized State with 62.2 percent urban population.

Statement 3 is correct. Among all the States and Union territories, the National Capital Territory of Delhi and the Union territory of Chandigarh are most urbanized with 97.5 percent and 97.25 percent urban population respectively, followed by Daman and Diu (75.2 percent) and Puducherry (68.3 percent). Thus, there is **no state or Union Territory with 100% urbanized population.**

105. Solution: (c)

Exp) Option c is the correct answer.

The rural settlement's pattern reflects the way the houses are sited in relation to each other. Rural settlements are classified based on a number of criteria:

1. **Basis of setting:** Plain and plateau villages, coastal villages, forest and desert villages
2. **Basis of functions:** Farming and fishermen's villages, lumberjack villages, pastoral villages.
3. **Basis of forms/shapes:** Linear, rectangular, circular star-like, T-shaped village, **double village**, cross-shaped village, etc

Option a is incorrect: In a Star-like pattern, several roads get converged. These settlements develop by the houses built along the roads.

Option b is incorrect: In T-shaped settlements, houses develop at tri-junctions of the road.

Option c is correct: Double village is a settlement that extends on both sides of a river where there is a bridge or a ferry.

Option d is incorrect: In the **Linear pattern, the houses are located along a road, railway line, river, canal edge of a valley, or along a levee.**

Important Tips

Other rural settelement patterns on basis of form/ shapes:

- **Rectangular pattern:** These are found in plain areas or wide intermontane valleys. The roads are rectangular and cut each other at right angles.
- **Circular pattern:** These villages develop around lakes, and tanks.

106. Solution: (d)

Exp) Option d is the correct answer

Suburbanization is a term to describe the growth and spatial reorganization of contemporary city.

Option a is incorrect: Overurbanization is a concept used by urbanization and development scholars to describe a situation in which a country's urban population is considerably larger than expected on the basis of that country's level of economic development.

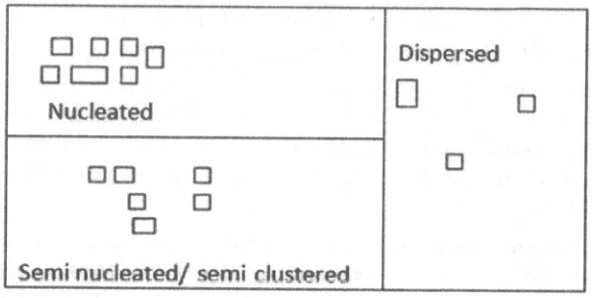
Option b is incorrect: Counter urbanisation and not sub-urbanisation is when large numbers of people move from urban areas into surrounding countryside or rural areas. This process is exact opposite of Urbanization. It is both a demographic (population driven) and social process, but has to a lesser extent also involved the movement of some businesses and economic activities.

Option c is incorrect: This is not related to Sub Urbanization and only highly highlights the negative impact of Urbanization process on Rural and tradition culture.

Option d is correct: Suburbanisation can be defined as the outward growth of urban development which may engulf surrounding villages and towns into a larger urban agglomeration. Indeed, the suburbs are the outlying areas of a city which are close enough to the city centre to be accessible by commuters. Essentially it is a part of urbanisation, in that it increases the proportion of people that live in towns and cities in comparison to those in rural areas. As suburbs grow they attract both people from rural areas AND people from Inner city and CBD areas, who are attracted by the greater amount of space within the suburb. Suburbanisation results in the physical spreading of a city into surrounding countryside areas, known as URBAN SPRAWL, and this puts pressure on greenfield sites and on nature.

107. Solution: (a)

Exp) Option a is the correct answer.



Pair 1 is correct. The settlement in which the **houses are closely built up** and compact is known as clustered settlement. It is **found in fertile alluvial plains.** People live in compact villages for security reasons. The shape of clustered settlement normally varies from rectangular, radial, to linear.

Pair 2 is correct. Semi-clustered or fragmented settlements may result from tendency of **clustering in a restricted area of dispersed settlement**. More often such a pattern may also result from segregation or **fragmentation of a large compact village**. In this case, one or more sections of the village society choose or is forced to live a little away from the main cluster or village. In such cases, generally, the land-owning and dominant community occupies the central part of the main village, whereas **people of lower strata of society** and menial workers **settle on the outer flanks** of the village. Such settlements are widespread in the Gujarat plain and some parts of Rajasthan.

Pair 3 is incorrect. Hamleted Settlement is a fragmented settlement **divided into several units physically separated** from each other bearing a common name. These units are locally called panna, para, palli, nagla, dhani, etc. in various parts of the country. This segmentation of a large village is often motivated by social and ethnic factors. Such villages are more frequently found in the middle and lower Ganga plain, Chhattisgarh and lower valleys of the Himalayas.

Whereas dispersed settlement pattern in India appears in the form of **isolated huts or hamlets** of few huts **in remote jungles**, or on small hills.

108. Solution: (b)

Exp) Option b is the correct answer.

Human geography studies the inter-relationship between the **physical environment and socio-cultural environment created by human beings through mutual interaction** with each other. Human beings interact with their physical environment with the **help of technology. Technology indicates the level of cultural development of society.**

Pair 1 is correct: Environmental determinism is the belief that the **environment, most notably its physical factors such as landforms and climate, determines the patterns of human culture and societal development.** Environmental determinists believe that ecological, climatic, and geographical factors alone are responsible for human cultures and individual decisions. Also, social conditions have virtually no impact on cultural development.

Pair 2 is correct: Environmental possibilism states that the environment sets limitations for cultural development, but it does not wholly define culture. **Culture is instead defined by the opportunities and decisions that humans make in response to dealing with such limitations.** Humans **create possibilities with the resources obtained from the environment**. This utilizing scope of the environment by humans with developed technology shows possibilism **(Nature provides opportunities and human beings make use of these)**.

Pair 3 is incorrect: Neo-determinism or stop and go determinism concept reflects a **middle path between the two ideas of environmental determinism and possibilism.** It means that **possibilities can be created within the limits which do not damage the environment** and there is no free run without accidents. The activities of man should be according to the laws of the environment, **otherwise, the environment also forces man to stop and adjust his activities.** For example, temperature rise due to greenhouse gases will lead to change in cultural sphere of temperate regions of Europe.

109. Solution: (c)

Exp) Option c is the correct answer.

Option a is incorrect: Demographic balancing equation is an equation that is used to calculate population changes from one year to the next in a given area, based on number of births, deaths, and migrations. The general form of the equation is a mass balance equation, in which end population = starting population ± natural increase ± net migration, where natural increase = births – deaths, and net migration = immigrants – emigrants.

The demographic window of opportunity refers to a period of time in a country's demographic transition where the **proportion of the working-age population is relatively high compared to the dependent population (children and the elderly).** During this period, there is a potential for rapid economic growth and development, as the working-age population can support a larger number of dependents and there is a higher ratio of productive workers to non-productive dependents.

110. Solution: (b)

Exp) Option b is the correct answer.

A Census town is a settlement that fulfils the criteria of being considered a town for the purposes of census. The criteria for being classified a census town are:

1. Population greater than 5000. **(Option 1 is incorrect)**
2. Population density greater than 400 persons per sq. Km. **(Option 2 is correct)**
3. At least 75% of the male main working population should be employed in non-agricultural sectors. **(Option 3 is correct)**

The number of census towns trebled from 1,362 to 3,894 during 2001-2011, accounting for 30% of the total rise in urban population of the country.

111. Solution: (a)

Exp) Option a is the correct answer.

A population pyramid is popularly known as "age pyramid" or "age and sex pyramid". It is a graphical representation of age structure or the distribution of population according to various age groups

Pair 1 is correctly matched: Expansive Pyramid is a population pyramid with broad base and with successive decline in the share of population of higher age groups is known as expansive pyramid. This pyramid **represents situation of high fertility, high mortality,** low life expectancy, higher population growth rates and low share of old age persons. It indicates expansion of population. Expansive age pyramids are common for developing countries mainly in Africa and Asia.

Pair 2 is incorrectly matched: Stationary Pyramid is a pyramid is described stationary when the share of population remains constant in different age groups over the period of time. **It represents situation of low fertility, low mortality and high life expectancy.** It indicates slow population growth or stable population. The stationary or near stationary population pyramid displays somewhat equal share of juvenile and adult age groups.

Pair 3 is incorrectly matched: Constrictive Pyramid is a pyramid with a narrow base is called constricted pyramid. It represents low fertility, low mortality, high life expectancy and ageing of population. **It is typically associated with very advanced countries which have a high level of literacy,** easy access to birth control measures and very good health and medical facilities.

112. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is correct: Technopolies is a society with a concentration of technology-based businesses. There is an emphasis on technology. They are high-tech industries that are regionally concentrated, self-sustained, and highly specialized. Silicon Valley near San Francisco and Silicon Forest near Seattle are examples of technopolies.

Statement 2 is incorrect: Neatly spaced, low, modern, dispersed, office-plant-lab buildings are the chief characteristics of the technopolies. **Technopolies do not have massive assembly structures, factories, and storage areas as in traditional industries.**

Statement 3 is correct: In the technopolies, White-collar (Professional) workers make up a large share of the total workforce. These highly skilled specialists greatly outnumber the Blue-collar (actual production) workers.

113. Solution: (d)

Exp) Option d is the correct answer.

For the purpose of **census 2011, a person aged seven and above, who can both read and write with understanding in any language,** is treated as literate. A person, who can **only read** but cannot write, is **not considered literate.**

According to the 2011 census, the total literacy rate in the country is 74.04%. The male literacy rate is 82.14% and female literacy rate is 65.46%.

Kerala remains the top state in literacy ranking in India with **93.91% literacy rate** followed by **Lakshadweep** with **92.28%** and **Mizoram** with **91.58%. Bihar** with a literacy rate of **63.82% ranks last in the country** preceded by Arunachal Pradesh (66.95%) and Rajasthan (67.06%).

114. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct: The Density of population is expressed as the number of persons per unit area. It helps in getting a better understanding of the spatial distribution of the population in relation to land. The density of population is a crude measure of human and land relationship. Population density is the concentration of individuals within a species in a specific geographic locale.

Statements 2 and 3 are correct: Growth of population is the change in the number of people living in a particular area between two points of time. The Growth rate is expressed in percentages. Population growth has two components namely; natural and induced. **The natural growth is analysed by assessing the crude birth and death rates and the induced components are assessed by the volume of inward and outward movement of people in any given area.**

115. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is correct: For centuries, the **Yanomami** have inhabited a vast area of pristine forest and meandering rivers on the border between **Brazil and Venezuela**, living off fishing, hunting and fruit gathering. The lust for gold and other valuable minerals that lay beneath their ancestral territory has in recent years attracted a wave of illegal prospectors who have cut down forests, poisoned rivers and brought deadly diseases to the tribe.

Pair 2 is incorrect: Maori people are the indigenous people of New Zealand, also known as Polynesian indigenous tribes. It is not clear to historians on their original land but it's a well-known fact that the Māori people arrived in New Zealand in the 1300's and currently make up 15% of the population.

Pair 3 is incorrect: The Bindibu were the native group of western Australia. They consisted of native peoples who practiced occupations like hunting, fishing and gathering etc.

Pair 4 is incorrect: Zulu people refer to themselves as 'the people of the heavens' and they are **the largest ethnic group of South Africa.**

116. Solution: (d)

Exp) Option d is the correct answer.

Population density is the concentration of individuals within a species in a specific geographic locale. The Food and Agriculture Organization and World Bank population estimates ranked the countries on basis of population density.

Option d is correct: The densely populated countries in the world are as follows:

1. Monaco - 19,361/km^2.
2. **Singapore - 8,019/km^2.**
3. Bahrain - 2,182/km^2.
4. **Maldives - 1,802/km^2.**
5. Malta - 1,642/km^2.
6. **Bangladesh - 1,265/km^2.**

India is having a population density of **464/ km^2.**

117. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: International Organization for Migration (IOM) is the leading intergovernmental organization in the field of migration and works closely with governmental, intergovernmental and non-governmental partners. It is a part of the United Nations System.

Statement 2 is incorrect: IOM was born in 1951 out of the chaos and displacement of Western Europe following the Second World War. It was set up to facilitate the resettlement of European migrants uprooted by the Second World War.

The dissolution of the Soviet Union occurred in 1991.

Statement 3 is correct: Since 2000, IOM has been producing its flagship World Migration Report every two years.

118. Solution: (d)

Exp) Option d is the correct answer.

Human development is a multi-faceted concept encompassing the expansion of **human freedoms and capabilities to live a fulfilling life.**

Key approaches include

1) The income approach;

2) The welfare approach;

3) Minimum needs approach; and

4) Capabilities approach.

Option a is incorrect- This option **captures the spirit of income approach to human development.** This approach, rooted in history, asserts a **direct correlation between human development and income.** It simplifies the relationship by emphasizing that an **individual's freedom increases with higher income levels.** The underlying belief is that improved income is synonymous with greater development, making economic prosperity a key determinant of individual freedom.

Option b is incorrect- This option **captures the spirit of welfare approach to human development.** The welfare approach places human beings at the **core of all development efforts,** viewing them **not merely as participants but as the primary recipients of development outcomes.** In this perspective, the government is seen as having a **central role in maximizing expenditures on welfare programs.**

Option c is incorrect- This option **captures the spirit**

of Basic approach to human development. Suggested by the **International Labour Organization (ILO)**, the concept entails ensuring the fulfillment of six fundamental requirements for all individuals. These needs encompass **Food, Water, Sanitation, Housing, health and education.**

Option d is correct- This option clearly captures the essence of the **Capability Approach** by highlighting its core elements: **building capabilities in key areas like health, education, and access to resources,** which ultimately leads to expanded individual freedom and agency. The capability approach, proposed by economist Amartya Sen, **views human development beyond income and focuses on people's capabilities to lead valuable lives.** It assesses individuals' freedoms and opportunities, emphasizing their ability to achieve well-being, rather than solely measuring economic outcomes or resources.

119. Solution: (a)

Exp) Option a is the correct answer.

Migration is the physical movement of people from one place to another.

Statement 1 is correct. As per the 2011 census, there were **21 crore rural-rural** migrants which formed **54% of classifiable internal migration** (the Census did not classify 5.3 crore people as originating from either rural or urban areas). **Rural-urban** and **urban-urban** movement accounted for **around 8 crore** migrants each. There were around 3 crore urban-rural migrants (7% of classifiable internal migration).

Statement 2 is incorrect. As per Census 2011 data on migration, **Maharashtra** has **highest number of migrants** in India. Of the 5.74 crore migrants in Maharashtra, 27.55 lakh reported their last place of residence to be **Uttar Pradesh**; 5.68 lakh said Bihar. Internal migration from within Maharashtra had the lion's share of migrants: 4.79 crore.

Statement 3 is incorrect. In India **five million** people from other countries are residing legally. The largest share of migrants in India is from **Bangladesh** followed by Pakistan and Nepal.

120. Solution: (a)

Exp) Option a is the correct answer.

Population growth is the **variation in the number of individuals residing in a specific area over a defined period,** and its rate is quantified as a **percentage.**

Statement 1 is incorrect- The period **1911-1921** saw a **negative population growth rate of -0.31%.** This is the **only time since 1900** when the population declined. The **influenza outbreak in 1918** led to a **surge in the country's mortality rate,** resulting in **14 million deaths.** Additionally, occurrences of **famine, plague, and malaria contributed to a population decline.**

Statement 2 is incorrect- India's population growth rate has been **continuously declining since 1980s.** In **1981,** the **population decadal growth rate of India was 24.66% and by 2011, it was 17.64%.**

Table 1.1 : Decadal Growth Rates in India, 1901-2011

Census Years	Total Population	Growth Rate*	
		Absolute Number	% of Growth
1901	238396327	----------	----------
1911	252093390	(+) 13697063	(+) 5.75
1921	251321213	(-) 772117	(-) 0.31
1931	278977238	(+) 27656025	(+) 11.60
1941	318660580	(+) 39683342	(+) 14.22
1951	361088090	(+) 42420485	(+) 13.31
1961	439234771	(+) 77682873	(+) 21.51
1971	548159652	(+) 108924881	(+) 24.80
1981	683329097	(+) 135169445	(+) 24.66
1991	846302688	(+) 162973591	(+) 23.85
2001	1028610328	(+) 182307640	(+) 21.54
2011**	1210193422	(+) 181583094	(+) 17.64

* Decadal growth rate: $g = \frac{P_2 - P_1}{P_1} \times 100$

where P_1 = population of the base year
P_2 = population of the present year

** Source : Census of India, 2011(Provisional)

Statement 3 is correct- India's Total Fertility Rate (TFR) has declined from 2.2 to 2.0 as per the fifth round of the **National Family Health Survey (NFHS-5).** There are now only five states that have a TFR above the replacement level of fertility of 2.1 children per woman: **Bihar (2.98)**, Meghalaya (2.91), Uttar Pradesh (2.35), Jharkhand (2.26), and Manipur (2.17). Hence, as per the National Family Health Survey (NFHS-5), Bihar has the highest Total Fertility Rate among the Indian states.

121. Solution: (d)

Exp) Option d is the correct answer.

The sex ratio is the ratio of males to females in a population.

Statement 1 is incorrect – The sex ratio at birth increased from 819 to 834 between 2001 and 2011 Census for Haryana. According to National Family Health Survey-5, it is 893. However, it is not the state with lowest Sex ratio at birth. **Rajasthan and Himachal Pradesh have 891 and 875 respectively, lower than that of Haryana.**

Statement 2 is incorrect - As per NFHS-5, the sex ratio at birth has improved from 919 in NFHS-4 to 929 in NFHS-5, an increase of 10 points. **Except for Tripura, Ladakh, and Lakshadweep,** all states/UTs have a child sex ratio of less than 1000.

122. Solution: (b)

Exp) Option b is the correct answer.

Population density refers to the **number of people living in a particular area.** It is typically expressed as the **number of people per square kilometre or square mile.** As per the **2011 Census of India**, the average population density of India is **382 persons per square kilometre.**

Option 1 is incorrect- Bihar has a population density of **1106 people per square kilometre.**

Option 2 is incorrect- Kerala has a population density of **860 people per square kilometer.**

Option 3 is correct- Odisha has a population density of **270 people per square kilometre.**

Option 4 is correct- Andaman and Nicobar have a population density of **46 people per square kilometre.** It is the **least densely populated Union Territory of India.**

Option 5 is correct- Arunachal Pradesh has a population of **17 people per square kilometre**. It is the **least densely populated state** in India.

123. Solution: (a)

Exp) Option a is the correct answer.

Migration is the movement of people away from their usual place of residence, across either internal (within country) or international (across countries) borders.

Statement 1 is correct: Intra-state movement accounted for majority of total internal migration. Intra-state movement accounted for **almost 88% of all internal migration (39.6 crore persons).** In contrast, there were 5.4 crore inter-state migrants. As of 2011, Uttar Pradesh and Bihar were the largest source of inter-state migrants while Maharashtra and Delhi were the largest receiver states.

Statement 2 is incorrect: As of 2011, majority (70%) of intra-state migration was due to **reasons of marriage and family (and not work)** with variation between male and female migrants. While 83% of females moved for marriage and family, the corresponding figure for males was 39%. Overall, 8% of people moved within a state for work (21% of male migrants and 2% of female migrants).

124. Solution: (d)

Exp) Option d is the correct answer.

Production involves the process of alteration of resources and/or value addition over goods produced. It takes place in five sectors of the economy and they are primary, **secondary, tertiary, quaternary and quinary.**

Options a and b are incorrect: Quaternary activities center around research, development and may be seen as an advanced form of services.

1) **Construction and development of renewable energy infrastructure** fall within the **quaternary sector**, which encompasses activities related to research, development, and adoption of advanced technologies like renewable energy.
2) **Companies engaging tax consultants and auditing firms** belong to the quaternary sector, which deals with advanced forms of services.

Option c is incorrect: Information technology and communication services fall within the **tertiary sector,** as they are services provided to improve efficiency and customer satisfaction.

Option d is correct: Quinary activities are often described as activities belonging to a **"fifth sector" beyond the traditional primary, secondary, tertiary, and quaternary sectors.** They focus on high-level strategic thinking, intellectual capital, and intangible value creation. **High-level decision-making and managerial roles** directly involve strategic planning, policy formulation, complex problem-solving activities that align with the characteristics of the quinary sector.

125. Solution: (c)

Exp) Option c is the correct answer

Transhumance refers to the **seasonal movement of people** who are typically herders, **along with their livestock, between different grazing lands.** This movement is driven by seasonal changes in resource availability, with herds typically moving to higher pastures in summer and lower valleys in winter.

Types of Transhumances:

1) **Vertical Transhumance:** The most common type involves moving livestock in an altitudinal pattern. Herders move to higher pastures in the summer where temperatures are cooler and fresh grazing is available, then descend to lower-elevation valleys or plains during the winter.
2) **Horizontal Transhumance:** Herders move livestock across long distances between different regions with varying seasonal rainfall and grazing patterns. This is common in arid or semi-arid environments where resources are scattered.

126. Solution: (c)

Exp) Option c is the correct answer

Labour force participation rate is defined as the **section of the working age population (in the age group of 16-64) in the economy currently employed or seeking employment.** People who are still undergoing studies, housewives and persons above the age of 64 are not reckoned in the labour force.

Option (a) is narrow, as it only considers individuals currently employed, excluding those actively seeking work.

Option (b) does not accurately represent LFPR as it uses the total population, while LFPR focuses on the working-age population.

Option (d) is incorrect because it includes the entire population, not just the working-age segment.

127. Solution: (c)

Exp) Option c is the correct answer.

Statement-I is correct: The year 1921 is considered a "demographic divide" in Indian history because it marks a turning point in the country's population growth trends. Here's why:

1) **Before 1921: There was an erratic and often stagnant growth of population. This stagnation was primarily due to high death rates and high birth rates.**
2) **After 1921: There was a consistent growth of population. After 1921, India started experiencing a steady decline in mortality rates due to improvements in public health measures and control of epidemics. However, the birth rates continued to be high. This combination of declining death rates and stable high birth rates led to a consistent period of population growth after 1921, leading to what's sometimes called a population explosion.**

Statement-II is incorrect: The first census in India was conducted in 1872, though it wasn't conducted synchronously throughout the entire country. The **first**

complete, synchronous census, where data was collected across all parts of India around the same time, took place in 1881.

128. Solution: (d)

Exp) Option d is the correct answer.

The **Organization for Economic Co-operation and Development** (OECD) the International Migration Outlook annually. This report analyzes recent migration trends and policies in its member countries and selected non-OECD countries.

129. Solution: (c)

Exp) Option c is the correct answer.

The **welfare approach** is one of the human development approaches that considers **human beings as the beneficiaries or targets of all development activities.** The welfare approach argues for **higher government expenditure on education, health**, social amenities, and other basic services to improve the quality of life of the people. However, the **welfare approach does not consider the people as active participants in the development process**, but only as passive recipients of the government's policies. Some critics of this approach say that it does not address the root causes of poverty and inequality, and that it may create dependency and inefficiency among the people.

Important Tips

1) **Income Approach:** This is one of the oldest approaches to human development. Human development is seen as being linked to income. The idea is that the level of income reflects the level of freedom an individual enjoys. Higher the level of income, the higher is the level of human development.
2) **Basic Needs Approach:** This approach was initially proposed by the International Labour Organisation (ILO). Six basic needs i.e.: health, education, food, water supply, sanitation, and housing were identified. The question of human choices is ignored, and the emphasis is on the provision of basic needs of defined sections.
3) **Capability Approach:** This approach is associated with Prof. Amartya Sen. Building human capabilities in the areas of health, education and access to resources is the key to increasing human development.

130. Solution: (c)

Exp) Option c is the correct answer.

Option a is incorrect: The physical separation of different social groups within a city, often based on income, race, or ethnicity: This statement describes a concept known as **'Spatial segregation'**, where different social groups are physically separated within a city based on various factors such as income, race, or ethnicity.

Option b is incorrect: The population shift from high density urban centres to lower density residential areas on the outskirts describes a phenomenon known as **'Suburbanization'** or urban sprawl, where people move from high density urban areas to lower density residential areas on the outskirts of a city.

Option c is correct: The process of wealthy individuals moving into a lower-income neighborhood, leading to economic and social changes, **accurately describes the concept of Gentrification.** Gentrification refers to the transformation of a lower-income or working-class neighborhood through the influx of more affluent residents, often accompanied by increased property values, changes in the local economy, and shifts in the cultural and social dynamics of the area. This process can lead to both positive and negative consequences, such as improved amenities and services but also displacement of long-time residents and changes in neighborhood character.

Option d is incorrect: Urban planning approach, that prioritizes development near public transportation hubs, encouraging walking, cycling, and public transit use while reducing reliance on personal vehicles. This process is called **Transient Orient development.**

131. Solution: (b)

Exp) Option b is the correct answer.

As per 2011 census of India, the most populated state in India was Uttar Pradesh, followed by Maharashtra, Bihar, West Bengal, Andhra Pradesh. Also, the top five least populated states were Sikkim, Mizoram, Arunachal Pradesh, Goa and Nagaland.

According to the 2011 Census of India, **the most populous among these four states was Maharashtra** with a population of 11,23,72,972. **Followed by Madhya Pradesh** with a population of 7,25,97,565. At third position comes **Tamil Nadu**, with a population 7,21,38,958 and **finally Karnataka** with a population of 6,11,30,704

Important Tips

Important facts regarding Census in India;

1) The Census exercise in India is a nationwide enumeration conducted by the **Registrar General and Census Commissioner of India, under the Ministry of Home Affairs.** It aims to collect demographic, social, and economic data of the population.
2) **The first census in India was conducted in 1872,** and first complete census in 1881, and it has been conducted every ten years since then.
3) The **Census Act of 1948** governs the conduct of the census, outlining the legal framework, data collection procedures, and responsibilities of officials.
4) The census provides valuable information for policymaking, planning, and allocation of resources.
5) It is the largest administrative exercise in the country, covering every state and union territory, and plays a crucial role in understanding India's population dynamics.

132. Solution: (a)

Exp) Option a is the correct answer.

In 1973, the **Dhebar Commission** established **Primitive Tribal Groups (PTGs)** as a distinct category, denoting tribal groups less developed. **In 2006, the Indian Government renamed PTGs as Particularly Vulnerable Tribal Groups (PVTGs).** PVTGs share common characteristics: they are typically homogenous with small populations, physically isolated, have simple social institutions, lack a written language, possess basic technology, and undergo change at a slower pace.

Statement 1 is correct: As per 2011 census, there are total 705 Scheduled tribes in India, and out of them **75 are officially notified as PVTG'S**. These 75 PVTG'S are spread across **17 states and one union territory**.

Statement 2 is incorrect: The criteria for a Tribe to be considered as a PVTG includes four criteria's;

1. Pre agricultural level of technology
2. Low level of literacy
3. Economic backwardness
4. A declining or stagnant population.

Whereas the criteria mentioned in the statement of the question, **"to demonstrate historical habitation in the forest and dependence on forest for livelihood needs" are among the criteria for a Forest Dwelling Scheduled Tribe to claim rights under Forest rights act (FRA).**

Statement 3 is incorrect: Among the 75 listed PVTG's of India. **Odisha has 13 PVTG's, which is the highest,** followed by Andhra Pradesh and Telangana (12), Bihar and Jharkhand (9), Madhya Pradesh and Chhattisgarh (7), Tamil Nadu (6), and so on.

Important Tips

Population of PVTG's:

1) In India, tribal communities constitute 8.6% of the total population and inhabit around 15% of the country's geographical area, including plains, forests, hills, and remote regions.
2) The **Sahariya** PVTG has the highest population with 450,217 members,
3) The **Sentinelese and Andamanese** PVTGs have very small populations of **39 and 43** individuals, respectively.

133. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: Caste census can be conducted only by Union government, whereas Caste survey can be conducted by both Union and State Governments.

1) **Caste Census:**
   a. A caste census is a comprehensive enumeration of the population based on caste
   b. In India, **the legal authority for carrying out a census, including a caste census, rests solely with the Union government** (central government).
   c. **Socio economic caste census** was conducted first time in independent India in 2011. But its findings were never made public.
   d. The **last time a comprehensive caste census was published in India was in 1931**, during British rule.
2) **Caste Survey:**
   a. A caste survey is a more localized or targeted **exercise and can be conducted by either the Union or State governments.**
   b. It **mainly focuses on collecting socio-economic data related to various castes.**
   c. Caste surveys are not mandated by a specific law but are undertaken for administrative and policy-making purposes

Statement 2 is correct: Since Independence, **several State governments in India like Bihar and Odisha have undertaken socio-economic caste surveys** to gather data on the social and economic status of different castes within their respective states. This data is crucial for formulating targeted policies and programs aimed at addressing the specific needs and challenges faced by different caste groups.

134. Solution: (d)

Exp) Option d is the correct answer.

Option a is incorrect. A mega city or megalopolis is a general term for cities together with their suburbs with a population of more than 10 million people.

Option b is incorrect. A town is a human settlement that is **larger than a village but smaller than a city.** It typically has a more developed infrastructure and a higher population density than a village, but it is not as large or densely populated as a city.

Option c is incorrect. A city may be regarded as a **leading town, which has outstripped its local or regional rivals.** Cities are much larger than towns and have a greater number of economic functions.

Option d is correct. The concept of **conurbation,** introduced by Patrick Geddes in 1915, refers to the **extensive urban development** arising from the **amalgamation of initially distinct towns or cities**. Examples of conurbations include Greater London, Manchester, Chicago, and Tokyo, where separate urban centers have blended together into a single continuous urban area.

135. Solution: (a)

Exp) Option a is the correct answer.

Population Pyramid or Age-sex pyramid refers to the composition of population in terms of the age and sex of people.

Option 1 is correct. The total population divided into various age groups is showcased in a population pyramid.

Option 2 is correct. Sex composition of the population is showcased in a population pyramid. The percentage of the total population, subdivided into males and females, in each of those age groups is visible.

Option 3 is incorrect. Literacy levels of the population are not inferred from a population pyramid. As per Census 2011, the literacy rate was the percentage of people aged seven and above who could read and write with understanding in any language.

136. Solution: (b)

Exp) Option b is the correct answer.

The **Total Fertility Rate (TFR)** represents the average number of children a woman would have during her lifetime. A **TFR of 2.1 is considered the replacement level**, meaning the population size remains stable without growth or decline. India has achieved a Total Fertility Rate (TFR) of 2.0 as per NFHS-5 (2019–21). This is aligned with the National Population Policy 2000 and the National Health Policy 2017.

Based on the National Family Health Survey (NFHS 5, 2019-21), the TFRs for the specified states are:

1. **Bihar has a TFR of around 3.0 (2019-2021).** This is well **above the replacement level** of 2.1. **Hence, option 1 is correct.**
2. **Meghalaya's TFR is approximately 2.9 (2019-2021).** This is **above the replacement level** of 2.1. **Hence, option 2 is correct.**
3. **Rajasthan's TFR stands at 2.0 (2019-2021).**This is **below the replacement level** of 2.1. **Hence, option 3 is incorrect.**
4. **Madhya Pradesh's TFR stands at 2.0 (2019-2021).** This is **below the replacement level** of 2.1.**Hence, option 4 is incorrect.**

137. Solution: (a)

Exp) Option a is the correct answer.

Stunting, wasting and infant mortality rates are some of the indicators being used in India to measure health of children.

Pair 1 is incorrect. Stunting refers to low height for the age of a child. It has reduced from 38.4% to 35.5% as per National family Health Survey-5.

Pair 2 is incorrect. Wasting refers to low weight for the height of a child. It has reduced from 21.0% to 19.3% as per National family Health Survey-5.

Pair 3 is correct. Infant mortality rate (or IMR) is defined as the number of infant deaths in a year per 1,000 live births during the year.

As per the National Family Health Survey-5 (2019-21), the Infant Mortality Rate (IMR) has reduced from 40.7 per 1000 live births in 2015-16 to 35.2 per 1,000 live births in 2019-21 at National Level.

138. Solution: (a)

Exp) Option a is the correct answer.

The tribal people throughout the country have rich traditions, cultures and heritage with unique lifestyles and customs

Statement 1 is correct. As per the Census 2011, the state of Madhya Pradesh has the largest tribal population in India. The state is home to a substantial proportion of the country's Scheduled Tribes (STs), including major tribes such as the Bhils and Gonds.

Statement 2 is incorrect. As per census 2011, the Bhil tribe is the largest tribal group in India, mainly found in the states of Madhya Pradesh, Maharashtra, Gujarat, and Rajasthan. Their population surpasses other major tribal groups such as the Gonds and Santhals. **Mundas are the 7th largest tribe as per the census 2011.**

139. Solution: (b)

Exp) Option b is the correct answer.

The median age of a country represents the age that divides the population into two equal halves—50% of the population is younger, and 50% is older than this age.

- It is a key demographic indicator that reflects **population structure, economic development, and future workforce trends.**
- Generally, countries with a **higher median age have aging populations**, while those with a **lower median age have a younger, growing population.**
- As per recent **United Nations Population Fund (UNFPA) reports**, the median ages for the given countries are:
  2. **China – 39 years**
  4. **Sri Lanka – 32.9 years**
  1. **India – 28.2 years**
  3. **Bangladesh – 27.6 years**

Hence, the correct sequence is: 2-4-1-3.

Note: The latest data of median age is with respect to 2023. For 2024 the median age has increased for all the countries, so the order does not change but the exact numbers are not yet updated.

140. Solution: (d)

Exp) Option d is the correct answer.

Pair 1 is correct. The Bushmen are indigenous hunter-gatherers primarily found in **Kalahari desert** of Africa including countries of **Namibia,** Botswana, and South Africa. They are nomadic hunters and food gatherers, growing no plants and domesticating no animals.

Pair 2 is correct. The Maasai tribe constitutes an indigenous ethnic ensemble in Africa, which include semi-nomadic populations that have established settlements in both **Kenya and northern Tanzania.** Their unique customs, traditions, attire, and proximity to the abundant national game reserves of East Africa have elevated the Maasai to a prominent status among African ethnicities.

Pair 3 is correct. Samburu Tribe, can be found in Samburu County of **Northern Kenya.** They are closely related to the Maasai tribe who also live in East Africa, and both these tribes also speak a similar language. Just like the Maasai, the Samburu tribe are a semi-nomadic people.

Pair 4 is correct. Māori's are the native inhabitants of **New Zealand.** They are known for their distinct traditional practice of intricate full-body and facial tattooing.

141. Solution: (b)

Exp) Option b is the correct answer.

The Gross Reproductive Rate (GRR) measures the average number of daughters a woman would give birth to during her reproductive years (15-49), assuming current fertility rates remain constant. **It measures the average number of female children a woman is expected to give birth during her entire reproductive span conforming to the age specific fertility rates (ASFRs) for a given year, if there is no mortality.** It is similar to the Total Fertility Rate (TFR) but focuses only on female births, as they are essential for population replacement. Unlike Net Reproductive Rate (NRR), GRR does not account for mortality rates before childbearing age.

142. Solution: (b)

Exp) Option b is the correct answer.

Urban sprawl refers to the unplanned and uncontrolled expansion of cities into surrounding areas. It often leads to environmental degradation, loss of agricultural land, higher transportation costs, and inefficient land use.

Unlike planned urban growth, which involves systematic development with proper infrastructure and zoning regulations, urban sprawl occurs haphazardly, often without adequate public services such as roads, sewage, and public transport. It can result in social and economic challenges, including increased traffic congestion, pollution, and strain on public resources.

143. Solution: (c)

Exp) Option c is the correct answer.

The gravity model of migration, inspired by Newton's law of universal gravitation, proposes that migration flows between **two urban centres are directly proportional to the product of their populations and inversely proportional to the square of the distance between them**. In simpler terms, larger populations tend to generate and attract more migrants, while greater distances act as a barrier to migration. This model suggests that the "pull" of a larger population and the "push" of proximity significantly influence migration patterns.

144. Solution: (b)

Exp) Option b is the correct answer.

India has a rich tribal diversity in the various parts of its territory.

Pair 1 is incorrect. The **Gaddi** is a semi-pastoral tribe living mainly in the Indian states of **Himachal Pradesh and Jammu and Kashmir**. The Gaddi live mainly in the Bharmour region of Himachal Pradesh and Chenab Valley of Jammu.

Pair 2 is incorrect. Mankidia tribe belongs to Odisha. They are a Particularly Vulnerable Tribal Group (PVTG) and are known for their hunting and food gathering practices. The name 'Mankidia' is from the Odia term 'Mankada'- a reference to their specialization in catching monkeys.

Pair 3 is correct. Jarawa tribe belongs to the Andaman and Nicobar Islands. They are known for their semi-nomadic lifestyle and reliance on forest resources. They inhabit the western coasts of South and Middle Andaman Islands, a region rich in biodiversity that supports their traditional way of life.

Pair 4 is correct. Reang tribe belongs to Tripura. They are a Particularly Vulnerable Tribal Group. Kaubru is their language and have Hojagiri dance.

145. Solution: (d)

Exp) Option d is the correct answer.

Growth of population is the change in the number of people living in a particular area between two points of time. Population growth has two components namely; natural and induced. Natural growth is the result of crude birth and death rates. The induced components are explained by the volume of inward and outward movement of people in any given area.

Statement I is incorrect. The decades of 1951-1981 are referred to as the period of population explosion in India. **The average annual growth rate during this period was as high as 2.2 per cent.**

Statement II is correct. The growth of population in India over the last one century has been caused by annual birth rate and death rate and rate of migration.

The decades of 1951-1981 are referred to as the period of population explosion in India. The population growth rates were very high **because there was a rapid fall in the mortality rate but the fertility rate of population remained high** in the country. The mortality rates fell due to improvement of living conditions of people at large, caused by developmental activities that were introduced.

Also, **increased international migration bringing in Tibetans, Bangladeshis, Nepalies and even people from Pakistan contributed to the high growth rate.**

146. Solution: (d)

Exp) Option d is the correct answer.

The speakers of major Indian languages belong to four language families such as Austric, Dravidian, Sino-Tibetan and Indo - Europeans which have their sub-families and branches or groups

Option 3: Sino-Tibetan languages, including Lepcha, Sikkimese, Garo, Bodo, Manipuri, and various Naga dialects, are spoken by approximately **0.85% of India's population**. These languages are primarily found in regions such as Jammu & Kashmir, Himachal Pradesh, Sikkim, Arunachal Pradesh, Assam, Nagaland, Manipur, Mizoram, Tripura, and Meghalaya.

Option 1: The Austric language family in India primarily includes languages such as Santali, Mundari, Bhumij, Birhor, Ho, Turi, Korku, Kharia, Juang, and Savara. **Speakers of this language family make up approximately 1.38% of India's population.** These languages are spoken across several states, including Meghalaya, the Nicobar Islands, West Bengal, Bihar, Odisha, Assam, Madhya Pradesh, and Maharashtra.

Option 2: There are 26 **Dravidian languages**, with major ones including Malayalam, Kannada, Tamil, and Telugu. **These languages are spoken by approximately 20% of India's population** and are primarily found in Tamil Nadu, Karnataka, Kerala, and Andhra Pradesh. Additionally, Dravidian language speakers can be found in parts of Madhya Pradesh, Odisha, Maharashtra, Bihar, and West Bengal.

Option 4: The Indo-European language family, which includes Hindi, Bengali, Marathi, Punjabi, Gujarati, and several others, is the largest linguistic group in India. It is spoken by nearly **73% of the population** and is prevalent in states such as Jammu & Kashmir, Punjab, Himachal Pradesh, Uttar Pradesh, Rajasthan, Haryana, Madhya Pradesh, Bihar, Odisha, West Bengal, Assam, Gujarat, Maharashtra, and Goa.

Hence the increasing order of language family in India is option d 3-1-2-4 : Sino-Tibetan(0.85%)- Austric(1.38%)- Dravidian(20%)- Indo-European(73%)

147. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is correct: Gaddis:

1. The Gaddis are a prominent tribal community primarily residing in **Himachal Pradesh**, particularly in the **Bharmour region of Chamba district**.
2. They are traditionally shepherds and pastoralists, moving seasonally between lower valleys and high-altitude pastures in search of grazing lands for their sheep and goats.
3. They follow a transhumance lifestyle, migrating to higher altitudes in summer and returning to lower regions in winter.

Pair 2 is incorrect: Lepchas

1. The Lepchas are an indigenous tribe residing primarily **in Sikkim, parts of West Bengal (Darjeeling Hills), Nepal, and Bhutan.**
2. They are one of the earliest known settlers of Sikkim and have a deep cultural and spiritual connection with Mount Kanchenjunga, which they consider sacred.
3. The Lepcha language belongs to the Tibeto-Burman family and has its own script.
4. **Mizoram is not their traditional habitat**; Mizoram is home to Mizo tribes such as Lushai, Hmar, Ralte, and Pawi.

Pair 3 is incorrect: Mankidia

1. The Mankidia tribe is classified as a **Particularly Vulnerable Tribal Group (PVTG) in Odisha.**
2. They primarily reside in forested areas and are semi-nomadic, relying on forest produce for survival.
3. **Mankidia** recently became the **sixth PVTG in Odisha** to receive **habitat rights** under the **Forest Rights Act (FRA), 2006.**
4. **Karnataka is not their native state**, as it is home to different tribal groups such as **Soligas, Jenu Kurubas, Hakki Pikkis and Todas.**

Pair 4 is incorrect: Chenchu

1. The Chenchus are **a hunter-gatherer** tribe residing primarily in **Andhra Pradesh, Telangana** (particularly in the **Nallamala forest region) and some parts of Odisha, and Karnataka.**
2. They play a significant role in the **Nagarjunasagar-Srisailam Tiger Reserve**, where they have been living for centuries.
3. The Chenchus have been facing challenges such as loss of traditional livelihood, land encroachment, and forced relocation due to conservation policies.
4. **Jharkhand is not their traditional habitat**, as the state is home to other tribal groups such as **Santhals, Oraons, and Mundas.**

148. Solution: (b)

Exp) Option b is the correct answer.

The **doctrine of possibilism** tries to explain the relationship of a human being with nature and environment in a different way; it puts humans at a higher level and regards it as an active agent. It is a principle which claims that Nature provides opportunities and human beings make use of these and slowly nature gets humanised and starts bearing the imprints of human endeavour. Febvre (1932) in 'A Geographical Introduction to History' stated 'there are no necessities, but everywhere possibilities; and man, as the master of these possibilities, is the judge of their use'.

The focus of this philosophy was **"Nature has set boundaries and has provided opportunities and possibilities for human settlement, but the way a person responds to these conditions or adjusts it depends on their way of life."**

149. Solution: (b)

Exp) Option b is the correct answer.

The Density of population is expressed as the number of persons per unit area. It helps in getting a better understanding of the spatial distribution of population in relation to land. The overall density of population in India as per Census 2011 is 382 persons per sq km.

Population data are collected through Census operations generally held every 10 years in our country. The most recent population Census for which data has been published is the Census 2011.

Bihar (1106), West Bengal (1028) and Uttar Pradesh (829) have higher densities among Northern States. Kerala (860) and Tamil Nadu (555) have higher densities among the peninsular States.

Option 1: As per Census 2011, **Uttar Pradesh** has a population density of **829 persons/ sq. km.**

Option 2: As per Census 2011, **Bihar** has a population density of **1106 persons/ sq. km.**

Option 3: As per Census 2011, **Tamil Nadu** has a population density of **555 persons/ sq. km.**

Option 4: As per Census 2011, **Kerala** has a population density of **860 persons/ sq. km.**

So, the correct ascending order is **Tamil Nadu (555) < Uttar Pradesh (829) < Kerala (860) < Bihar (1106).**

150. Solution: (b)

Exp) Option b is the correct answer.

Statement 1 is incorrect: The first census in India was conducted in 1871, but it was done non-synchronously. The first synchronous census was held in 1881, not 1911. Synchronous census is a census that is conducted at the same time across a country or region

Statement 2 is correct: The Ministry of Home Affairs is responsible for overseeing the Census of India. The Office of the Registrar General and Census Commissioner of India, which falls under this ministry, conducts the census.

Statement 3 is incorrect: While general census data is made available for public access, complete individual-level data is restricted to protect the privacy of citizens, and only aggregated data is generally available to the public.

151. Solution: (d)

Exp) Option d is the correct answer.

Demographic transition theory can be used to describe and predict the future population of any area. The theory tells us that the population of any **region changes from high births and high deaths to low births and low deaths as society progresses from rural agrarian and illiterate to urban industrial and literate society**. These changes occur in stages which are collectively known as the demographic cycle.

Major stages of Demographic Transition:

Five stages of demographic transition are as follows:

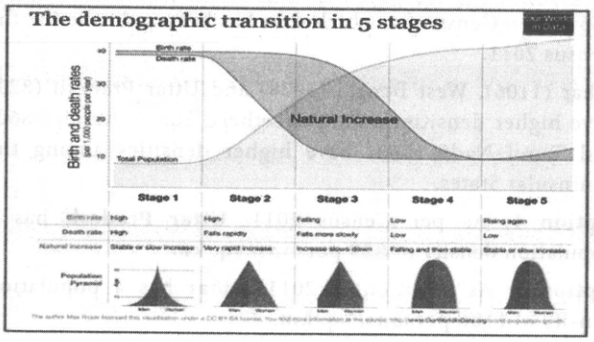
Stage 1- High and fluctuating birth and death rate with very slow population growth

Stage 2- High birth rate and declining death rate with rapid population growth rate

Stage 3- Slowly declining birth rate and low death rate and low declining rate of population growth

Stage 4- Low birth and death rate and slow population growth

Stage 5- Approximately equal birth and death rate that result in zero population growth



152. Solution: (d)

Exp) Option d is the correct answer.

Option a is incorrect. Physiological density refers to the ratio of total population of a country and its net cultivated area. Physiological density is a calculation of how many people in the country are supported by a unit of arable land. This can reveal how much pressure is put on the country's land to produce enough food for the population.

Physiological density = total population / net cultivated area.

Option b is incorrect. Agricultural density is the ratio of agricultural population of a country and **its net cultivable area. (Not the total area of that country).**

Option c is incorrect. Crop yield is a standard measurement of the amount of agricultural production harvested per unit of land area.

Option d is correct. Agricultural density is the ratio of total agricultural population of a country and its net cultivable area. Agricultural Density measures the number of people engaged in farming per unit area of arable land.

Agricultural density = total agricultural population / net cultivable area

The agricultural population includes cultivators and agricultural labourers and their family members.

153. Solution: (b)

Exp) Option b is the correct answer.

India has undergone major changes within the economy over the past decades between 1950–51 and 2014–15 and this has influenced the land-use changes in the country.

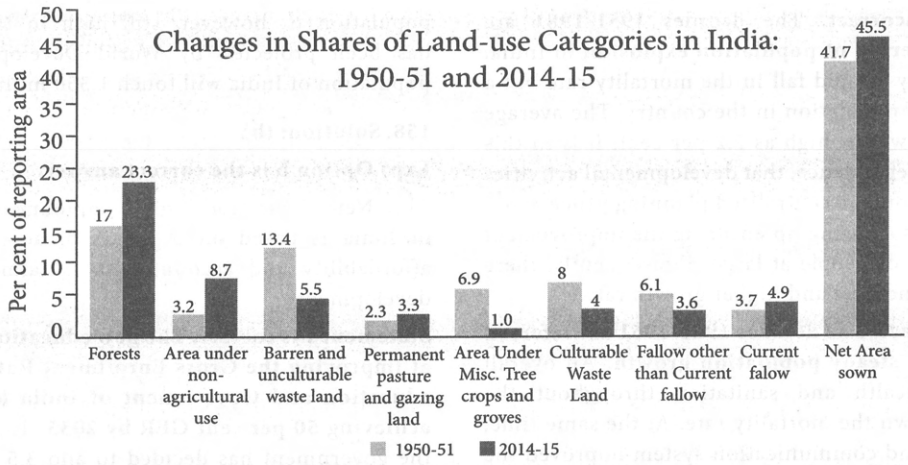
Statement b is incorrect: The **rate of increase is the highest in the case of area under non-agricultural uses** over the period between 1950-51 and 2014-15. This is due to the changing structure of the Indian economy, which is increasingly dependent on the contribution from industrial and services sectors and the expansion of related infrastructural facilities. An expansion of area under both urban and rural settlements has also added to the increase. Thus, the **area under non-agricultural uses is increasing at the expense of wastelands and agricultural land.**

Statement a is correct: The **total land area under forests has increased** between 1950-51 and 2014-15. The increase in the share of area under forest can be accounted for by an **increase in the demarcated area under forest** rather than an actual increase in the forest cover in the country.

Statement c is correct: The **area under permanent pastures and grazing land has increased** between the period between 1950-51 and 2014-15. This increase can be accounted for by the increase in livestock population.

Statement d is correct: The **area under tree crops and groves has registered a decline.** The decline in land under tree crops and groves can be explained by pressure from agricultural land.

As the pressure on land increased, both from the agricultural and non-agricultural sectors, the wastelands and culturable wastelands have witnessed a decline over time.



154. Solution: (b)

Exp) Option b is the correct answer.

Population growth is the increase in the number of people in a population. India's current annual population growth rate is 1 per cent.

Statement 1 is incorrect. India had a negative population growth rate **in 1921** decadal census. The country's population growth rate was negative by 0.31 percent.

Statement 2 is correct. In 1961 and 1971, the population growth rate was 21.51 percent and 24.80 percent respectively. In 1981, it became 24.66 percent. After that, the decadal growth rate of country's population though remained high, has **started slowing down gradually.** It was 23.85 percent in 1991, 21.54 percent in 2001 and 17.64 percent in 2011.

155. Solution: (d)

Exp) Option d is the correct answer.

Urbanization is the process through which cities grow, and higher and higher percentages of the population comes to live in the urban areas.

Statement 1 is incorrect: Although the absolute number of urban populations is increasing constantly, the growth rate has been variable.

Census Year	Urban Population (in million)	Percentage Urban	Annual Exponential Urban Growth Rate (%)
1961	78.94	17.97	-
1971	109.11	19.91	3.23
1981	159.46	23.34	3.79
1991	217.18	25.72	3.09
2001	286.12	27.86	2.75
2011	377.10	31.16	2.76

As the 1981 Census was not conducted in Assam, and the 1991 Census was not held in Jammu and Kashmir, the population of India includes projected figures for these states in those periods.
Source: Census of India, various years.

Statement 2 is incorrect: Both the urban and rural population has been consistently increasing although the rate of increase has declined.

Statement 3 is incorrect: Japan's capital Tokyo has the largest population of the world's capital cities at over 37 million people. This was followed by Delhi (India) at over 28 million; Mexico City (Mexico) at 21 million; and Cairo (Egypt) with 20 million. Across the world the most common capital size was in the range of 1 to 5 million people.

156. Solution: (b)

Exp) Option b is the correct answer.

Warabandi is a system of **rotation of supply of water** according to a **predetermined schedule as per area and crop needs** specifying the **day, time and duration of supply to each holding to ensure equitable water distribution** among farmers of an outlet command.

The Warabandi system of water distribution is **followed for canal irrigation system** at many parts in India including Madhya Pradesh. It is observed that **tail end fields receive less amount of water compared to fields situated at or near the head of water courses.** This is because of seepage losses in unlined water courses.

Warabandi system is **a rotational water allocation system which can fulfil the requirement of equality.** Warabandi is an Urdu word that combines wahr ("turn") and bandi ("fixed)". So "warabandi" means "rotation of water supply according to a fixed schedule". Warabandi system helping farmers can be allocated the same volume of water after the systematic rotation of water as the system will equalize the water allocation according to the regular and approved time schedule including the day supply will start, and for how long.

157. Solution: (a)

Exp) Option a is the correct answer.

The history of growth in India's population can be divided into four distinct phases – the points of division being 1911, 1921, 1951 and 1981.

Statement 1 is incorrect. The decades **1951-1981** are referred to as **the period of population explosion** in India, which was caused by a rapid fall in the mortality rate but a high fertility rate of population in the country. The average annual growth rate was as high as 2.2 per cent. It is in this period, after the Independence, that developmental activities were introduced through a centralised planning process and the economy started showing up ensuring the improvement of living conditions of people at large. Consequently, there was a high natural increase and higher growth rate.

Statement 2 is correct. The decades **1921-1951 are referred to as the period of steady population growth.** An overall improvement in health and sanitation throughout the country brought down the mortality rate. At the same time, a better transport and communication system improved the distribution system. The crude birth rate remained high in this period leading to higher growth rate than the previous phase. This is impressive at the backdrop of the Great Economic Depression, 1920s and World War II.

Statement 3 is incorrect. The period from 1901-1921 is referred to as a period of stagnant or stationary phase of growth of India's population, since in this period growth rate was very low, even recording a **negative growth rate during 1911-1921. Both the birth rate and death rate were high** keeping the rate of increase low. Poor health and medical services, illiteracy of people at large and inefficient distribution system of food and other basic necessities were largely responsible for high birth and death rates in this period.

Statement 4 is correct. In the post 1981 till present, the growth rate of country's population though remained high, has started slowing down gradually. A **downward trend of crude birth rate is held responsible for such a population growth**. This was, in turn, affected by an increase in the mean age at marriage, improved quality of life particularly education of females in the country. The growth rate of population is, however, still high in the country, and it has been projected by World Development Report that population of India will touch 1,350 million by 2025.

158. Solution: (b)

Exp) Option b is the correct answer.

The New Education Policy announced by Government of India is based on 5 pillars of access, equity, quality, affordability and accountability is aimed for sustainable development.

Statement 1 is correct. The new education policy 2020 aims at improving the Gross Enrollment Rate (GER) in higher education and Government of India has set a target of achieving 50 per cent GER by 2035. To achieve this target, the government has decided to add 3.5 crore new seats in Higher Education Institutions of India by 2035.

Statement 2 is correct. The literacy rate of 69% among Muslim Women was higher than the rate among women of ST (61%) and SC (64%).

Statement 3 is incorrect. In India, scheduled caste and scheduled tribe and other backward class are officially recognized by the constitution as groups of disadvantaged indigenous people. The literacy rate of the total population in the country was **about 73 percent in 2011,** in comparison to about **66 percent among the scheduled caste** population. As per Census 2011, literacy rate of **Scheduled Tribes (STs) was 59%.**

Important Tips

According to the All India Survey of Higher Education (AISHE) 2019-20, the gross enrolment ratio (GER) in higher or tertiary education increased to 27.1% (38.5 million), from 26.3% (37.4 million) in the preceding year.

This indicates that the remaining 72.9% of the population in the 18-23 age group is not enrolled in higher education institutions (HEIs).

GENERAL GEOGRAPHY

MAPPING

7.1. Mapping Based

1. With reference to the territories in the news recently and the countries to which they belong, consider the following pairs:

Territories in News	Countries
1. Transnistria	Ethiopia
2. Nagorno-Karabakh	Egypt
3. Falkland Islands	Ukraine

Which of the pairs given above is/are correct?
(a) 1 and 2 only
(b) 2 only
(c) 3 only
(d) None of the above

2. Which one of the following straits is nearest to the International Date Line?
(a) Malacca Strait
(b) Bering Strait
(c) Strait of Florida
(d) Strait of Gibraltar

3. With reference to active volcanic mountains, consider the following pairs:

Volcanic Mountain	Country
1. Mount Merapi	Indonesia
2. Mount Mayon	Philippines
3. Mount Etna	Italy
4. Mount Nyiragongo	United States of America

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

4. With reference to places recently in the news, consider the following pairs:

Place	Country
1. Agalega Island	Mauritius
2. Wadge Bank	Indonesia
3. Baltimore	Australia

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

5. Consider the following information:

Mountain Range	Location	Type of Mountain
1. Atlas	Africa	Fold Mountain
2. Andes	South America	Block Mountain
3. Sierra Nevada	North America	Block Mountain
4. Altai	Australia	Volcanic Mountain

In how many of the above rows is the given information correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

6. Consider the following pairs regarding the disputed territories of the world:

Disputed Territories	Dispute Between
1. Migingo Island	Uganda and Tanzania.
2. Nagorno-Karabakh	Armenia and Azerbaijan.
3. Kuril Island	Japan and Russia.
4. Senkaku Island	Japan and China.

Which of the pairs given above are correct?
(a) 1 and 2 only
(b) 3 and 4 only
(c) 1, 2 and 3 only
(d) 2, 3 and 4 only

7. Consider the following ocean trenches:
1. Mariana Trench
2. Tonga Trench
3. Puerto Rico Trench
4. Izu–Ogasawara Trench

How many of the above trenches are located in the Pacific Ocean?
(a) Only one
(b) Only two
(c) Only three
(d) All four

8. Consider the following information:

Lake	Region	Significance
1. Lake Titicaca	South America	Highest navigable lake in the world.
2. Caspian Sea	Central Asia	Largest lake in the world
3. Lake Baikal	Eastern Africa	Deepest lake in the world

In how many of the above rows is the given information correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

9. Consider the following pairs:

Name of Strait	Water bodies it connects
1. Strait of Gibraltar	Atlantic Ocean and Mediterranean Sea
2. Strait of Bosphorus	Red Sea to Gulf of Aden
3. Bab-el-Mandeb Strait	Black Sea and Sea of Marmara
4. North Channel	Atlantic Ocean to Irish Sea

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

10. Consider the following pairs:

Mountain Ranges	Related Countries
1. Zagros	Uzbekistan
2. Carpathian	Ukraine
3. Ural	Turkey
4. Altai	Afghanistan

How many of the above pairs are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

11. Which of the following groups of countries shares a land border with 'Golan heights', a place sometimes mentioned in the news?
(a) Israel, Iran, Lebanon and Jordan.
(b) Syria, Lebanon, Jordan and Israel.
(c) Turkey, Israel, Syria and Jordan.
(d) Israel, Syria, Lebanon and Egypt.

12. What is common among Lake Toba, Taal lake and Ojos del Salado Lake?
All of them-
(a) are formed by glacial activities.
(b) have recently been added to the Montreux record of the Ramsar convention.
(c) are volcanic crater lakes, created due to past volcanic activities.
(d) are the result of karst topography formed by the dissolution of soluble rocks.

13. Consider the following pairs:

Volcano	Located in
1. Mount Merapi	Indonesia
2. Mount Mayon	Philippines
3. Mount Shishaldin	United States of America (USA)

How many of the above pairs are correctly matched?
(a) Only one
(b) Only two
(c) All three
(d) None

14. With reference to various Isthmus in the world, consider the following pairs:

Isthmus	Connects the landmasses of
1. Isthmus of Kra	Malay Peninsula with continental Southeast Asia
2. Isthmus of Panama	North America and Southc America
3. Isthmus of Suez	Africa and Europe
4. Isthmus of Tehuantepec	Peloponnese and mainland of Greece

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

15. Consider the following countries:

1. Laos.
2. Philippines.
3. Brunei.
4. Indonesia.
5. Malaysia.

How many of the above countries border the South China Sea?

(a) Only two
(b) Only three
(c) Only four
(d) All five

16. The Big Trunk Route, an important international trade route, connects which of the following continents?

(a) Europe and Asia
(b) North America and Africa
(c) North America and South America
(d) Europe and North America

17. With reference to tunnels in India, consider the following pairs:

Tunnel	Location
1. Sela Tunnel	Sikkim
2. Shinku La Tunnel	Uttarakhand
3. Sonamarg Tunnel	Jammu and Kashmir
4. Atal Tunnel	Himachal Pradesh

How many of the above pairs are correctly matched?

(a) Only one
(b) Only two
(c) Only three
(d) All four

7.2. Miscellaneous

18. Consider the names of the shifting cultivation and the regions in which they are being practiced:

List I (Shifting cultivation)	List II (Regions)
1. Dipa	Bastar District (Chhattisgarh)
2. Kumari	Western Ghats
3. Valre	Jharkhand

Which of the above pairs is/are correctly matched?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

19. The Kolkhoz Model became the predominant form of agricultural enterprise in the first half of twentieth century in the erstwhile Soviet Union. In this context, the term Kolkhoz model is best related to which of the following?

(a) Market Gardening and Horticulture
(b) Dairy Farming
(c) Mixed Farming
(d) Collective Farming

20. 'Cropping Intensity' increases in which of the following conditions?

(a) When a greater number of crops are cultivated in a particular area during a specific period.
(b) When crops with less maturity period are replaced by plantation crops
(c) When the investment per unit of land increases substantially.
(d) When large amounts of fertilizers and pesticides are used over a land area.

21. Consider the following pairs related to various agricultural revolutions happened in India:

List I (Revolution)	List II (Associated with)
1. Grey Revolution	Fertilizer production
2. Golden Revolution	Honey and Horticulture
3. Silver Revolution	Cotton production

Which of the pairs given above is/are correct?

(a) 1 only
(b) 1 and 2 only
(c) 2 and 3 only
(d) 1, 2 and 3

22. Consider the following statements regarding the Hydrological Cycle:

1. The total volume of water in the global hydrological cycle remains constant.
2. The distribution of water on continents and within local drainage basin remains same always.

Which of the statements given above is/are correct?

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

23. Consider the following pairs:

Island	Type of island
1. Madagascar Island	Barrier Island
2. Greenland Island	Continental Island
3. British Isles	Tidal Island

How many of the pairs given above are correctly matched?

(a) Only one
(b) Only two
(c) All three
(d) None

24. Consider the following statements regarding the impacts of climate change on biodiversity:

1. The population of jellyfish is rapidly declining due to rising sea temperatures.
2. The yields of olive crops have substantially increased all over the world due to rising temperatures.
3. The mammals called Bramble Cay Melomys have become extinct primarily due to climate change.

Which of the above given statements is/are correct?

(a) 3 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) None of the above

25. Consider the following countries:

1. Bangladesh
2. Sri Lanka
3. Malaysia
4. Nepal
5. Thailand
6. Myanmar

How many of the countries are members of the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)?

(a) Only three
(b) Only four
(c) Only five
(d) All six

26. Consider the following statements with regards to the Mixed Farming:

1. As far as agriculture components are concerned, only one type of crop is grown at a time in mixed farming.
2. In mixed farming, emphasis is laid both on crop cultivation and animal husbandry.
3. Mixed farming is generally practiced in highly developed regions like Northwestern Europe and Eastern North America.

Which of the above given statements is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 2 only
(d) 3 only

27. With reference to the various categories of roads in India, consider the following:

1. National Highways
2. State Highways
3. District Roads
4. Village Roads

Arrange the above in the decreasing order of their total length in India:

(a) 3-4-2-1
(b) 3-1-2-4
(c) 4-3-2-1
(d) 4-3-1-2

28. With reference to the road connectivity projects in India, which of the following statements is/are correct?

1. The North-South corridor under the Golden Quadrilateral Project connects Srinagar in Jammu & Kashmir with Kanyakumari in Tamil Nadu.
2. The East-West Corridor under the Golden Quadrilateral Project connects Silchar in Assam with Porbandar in Gujarat.

Select the correct answer using the code given below:

(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

29. With reference to the Border Roads Organisation (BRO), consider the following statements:

1. It is the implementing agency of the Vibrant Villages Programme, which aims to enhance infrastructure and foster socio-economic development in select border villages.
2. It functions under the administrative control of the Ministry of Road Transport and Highways.

Which of the statements given above is/are correct?
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

30. In context to the sectors of the economy, consider the following:
1. Research and Development (R&D)
2. Transportation
3. Real Estate

How many of the above constitute a part of the service sector of the economy?
(a) Only one
(b) Only two
(c) All three
(d) None

31. With reference to Mediterranean Agriculture, consider the following statements:
1. It is practiced in southern California, central Chile and south western parts of South Africa.
2. Viticulture and Orchard farming are the characteristics of Mediterranean Agriculture.
3. Hard Winter Wheat is one of the primary food crops grown in Mediterranean Agriculture.

Which of the statements given above is/are correct?
(a) 1 and 2 only
(b) 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

32. The shifting cultivation or the slash and burn agriculture is prevalent in different countries of tropical regions in different names. In this context consider the following pairs:

Name of Shifting Cultivation	Associated country
1. Milpa	Indonesia
2. Ladang	Malaysia
3. Chena	Sri Lanka
4. Jhuming	Venezuela

How many of the pairs given above are correctly matched?
(a) Only one
(b) Only two
(c) Only three
(d) All four

33. In context of Zero Budget Natural Farming (ZBNF), the term 'Waaphasa' refers to:
(a) Microbial coating of seeds with formulations of cow urine and cow dung.
(b) Gradual reduction of chemical fertilizers by using green manure.
(c) Building up of soil humus to increase soil aeration.
(d) Adoption of integrated insect and pest management methods.

34. On the planet earth, most of the freshwater exists as ice caps and glaciers. Out of the remaining freshwater, the largest proportion
(a) is found in atmosphere as moisture and clouds
(b) is found in freshwater lakes and rivers
(c) exists as groundwater
(d) exists as soil moisture

35. Consider the following statements:
1. Antarctic glaciers terminate in the sea as floating ice shelves.
2. Antarctic glaciers are not affected by ocean currents.
3. Antarctic region experiences some warming due to tropospheric westerlies.

Which of the statements given above is/are correct?
(a) 1 only
(b) 1 and 3 only
(c) 2 only
(d) 1, 2 and 3

36. With reference to the water on the planet Earth, consider the following statements:
1. The amount of water in the rivers and lakes is more than the amount of groundwater.
2. The amount of water in polar ice caps and glaciers is more than the amount of groundwater.

Which of the statements given above is/are correct
(a) 1 only
(b) 2 only
(c) Both 1 and 2
(d) Neither 1 nor 2

SOLUTIONS

7.1. Mapping Based

1. Solution: (d)

Exp) Option d is the correct answer.

Pair 1 is incorrect: Transnistria – officially called the Pridnestrovian Moldavian Republic – is a narrow strip of land between **Moldova and western Ukraine.** It is an **unrecognized break-away state** that left Moldova after the collapse of the Soviet Union in 1990. It has de-facto independence, but it is **not recognized so by the UN.** Transnistria retains its independence largely due the military support provided by the Russian army stationed in the Transnistrian territory. It is internationally recognised as part of Moldova

Pair 2 is incorrect: Nagorno-Karabakh is a **landlocked, mountainous and forested region** within the boundaries of Azerbaijan. It is a disputed territory **internationally recognized as part of Azerbaijan** but mostly governed by the Republic of Artsakh, de facto independent state with an Armenian ethnic majority backed by neighbouring Armenia. It is located in the **South Caucasus region,** which straddles the border between Eastern Europe and Western Asia and spans the southern part of the Caucasus mountains. It is roughly made up of modern-day Armenia, Azerbaijan, and Georgia. The capital of Nagorno-Karabakh is Stepanakert.

Pair 3 is incorrect: Falkland Islands is an **archipelago in the South Atlantic Ocean.** The Islands have internal self-governance, and the **UK takes responsibility for their defence and foreign affairs.** The Government of Argentina has recently launched a campaign demanding negotiation with the UK to settle the territorial dispute over the Falkland Islands. The dispute has been continuing since the early 19th century. Both countries fought a war in 1982 over the dispute. The result was the UK's victory. At present, Falkland Island continues to operate as a self-governing British Overseas Territory.

2. Solution: (b)

Exp) Option b is the correct answer.

The **international date line** passes through the mid-Pacific Ocean and roughly follows a 180 degrees longitude north-south line on the Earth. It is located halfway around the world from the prime meridian — the 0 degrees longitude line in Greenwich, England.

Option b is correct. The Bering Strait is a **strait between the Pacific and Arctic oceans**, separating the Chukchi Peninsula of the Russian Far East from the Seward Peninsula of Alaska.

The Bering Strait is nearest to the International Date line. The International Date Line runs between the Diomede Islands and St. Lawrence Islands located in the middle of the strait.

Options a, c and d are incorrect.

Malacca Strait: The Strait of Malacca is a narrow stretch of water, 580 mi (930 km) in length, between the Malay Peninsula (Peninsular Malaysia) and the Indonesian island of Sumatra.

- **Strait of Florida**: The Straits of Florida is a strait located south-southeast of the North American mainland, between the Gulf of Mexico and the Atlantic Ocean.
- **Strait of Gibraltar:** The Strait of Gibraltar also known as the Straits of Gibraltar is a narrow strait that connects the Atlantic Ocean to the Mediterranean Sea and separates the Iberian Peninsula in Europe from Morocco in Africa.

3. Solution: (c)

Exp) Option c is the correct answer.

Pair 1 is correct: Mount Merapi – Indonesia

1. **Location: Central Java**, Indonesia.
2. **Type: Stratovolcano.**
3. **Activity:** It is the most active volcano in Indonesia, and one of the most active in the world.
4. **Recent Eruption:** Merapi erupted multiple times in 2023 and 2024, sending ash plumes and pyroclastic flows down its slopes, leading to evacuations in surrounding villages.
5. **Significance:** Its name, "Merapi," translates to "Mountain of Fire" in Javanese.

Pair 2 is correct: Mount Mayon – Philippines

1. **Location:** Luzon, Philippines (**Albay Province**).
2. **Type: Stratovolcano**, known for its symmetrical cone shape.
3. **Activity**: Mayon is the most active volcano in the Philippines, it has erupted around 50 times in the past 400 years.
4. **Recent Eruption**: In June 2023, Mayon began erupting, prompting authorities to declare a state of calamity in Albay. Thousands of residents were evacuated due to lava flows and ashfall.
5. **Significance:** Famous for its **near-perfect cone shape**, making it a major tourist attraction.

Pair 3 is correct: Mount Etna – Italy

1. **Location: Sicily**, Italy.
2. **Type: Stratovolcano**, and the tallest active volcano in Europe.
3. **Activity**: Most active volcano in Europe and one of the most active in the world, Mount Etna has frequent eruptions, with ongoing activity recorded for thousands of years.
4. **Recent Eruption**: In February 2025, Mount Etna experienced eruptions that attracted thousands of tourists. The influx of visitors, many ill-prepared for the conditions, led to numerous rescue operations.

5. **Significance:** It is a **UNESCO World Heritage Site**, and plays a vital role in local culture and mythology. It is believed to have been the forge of Vulcan, the Roman god of fire

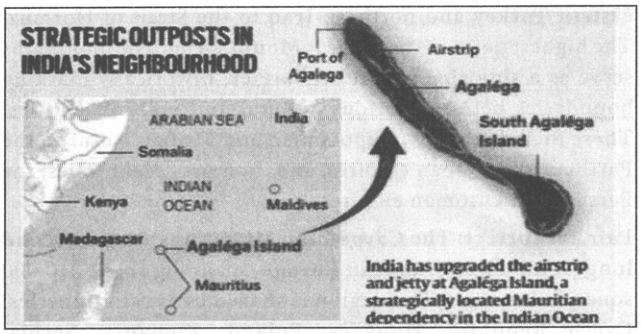
Pair 4 is incorrect: Mount Nyiragongo – Democratic Republic of the Congo (DRC).

1. **Location:** Democratic Republic of the Congo (DRC), within Virunga National Park.
2. **Type:** Stratovolcano
3. **Activity:** One of the most active volcanoes of Africa.
4. **Recent Eruption**: In 2021, a major eruption caused lava flows, displacing thousands of people.
5. **Significance:** It is situated in the Virunga mountains and is known for its persistent lava lake.

4. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is correct: Agalega Island belongs to Mauritius and is situated about 1,050 km north of Mauritius. It consists of **two islands** with a total area of 26 sq km. Recently, India and Mauritius inaugurated developmental projects on Agalega Island.



Pair 2 is incorrect: Wadge Bank is part of India, not Indonesia. It is a 10,000 sq km marine area, approximately 50 km **south of Kanyakumari**. It is rich in biodiversity and an important fishery resource for India.

Pair 3 is incorrect: Baltimore is in the **United States of America (Maryland province), not Australia**.

It is located along the Patapsco River near the Chesapeake Bay, it was the 17th largest port in the U.S. in 2021. It is also the **largest vehicle-handling port in the U.S.**

5. Solution: (b)

Exp) Option b is the correct answer.

Row 1 is correct. The Atlas Mountains are a mountain range in North Africa. The mountains stretch some 2400 km through Morocco, Algeria and Tunisia. The range forms a natural barrier between the Sahara Desert and the coast.

Atlas is a fold mountain. Approximately 65 to 50 million years ago, the northern edge of the African Plate began to collide with the southern edge of the Eurasian Plate. This collision initiated a process known as continental collision or orogenesis. The edges of the two plates crumpled and folded, giving rise to the Atlas Mountain range.

Row 2 is incorrect. The Andes are among the world's longest mountain chains. They are fold- mountains. They stretch along the entire west coast of South America. The stretch from Colombia in the north and through Ecuador, Peru, Bolivia, Chile and Argentina to the south. Here, the dense oceanic crust of the Nazca plate is subducting beneath the less-dense continental crust of the South American plate. The Andes are **mostly being folded and uplifted from the thicker, less-dense rocks of the South American plate.**

Fold mountains are created where two or more of Earth's tectonic plates are pushed together. **The Himalayas, Andes, Appalachians, and Alps are all active fold mountains.**

Row 3 is correct. The Sierra Nevada is a mountain range in North America. The Sierra Nevada is a massive block mountain range that broke free along a bounding fault line.

Block mountains are formed by the Earth's crust stretching and pulling apart. They are characterized by uplifted blocks of crust separated by faults.

Row 4 is incorrect. Altai Mountains are a mountain system of Central Asia extending approximately 2,000 km. It extends from Gobi (Desert) to the West Siberian Plain, through China, Mongolia, Russia, and Kazakhstan.

6. Solution: (d)

Exp) Option d is the correct answer.

Pair 1 is incorrect: The Migingo island is the center of a territorial dispute between Kenya and Uganda. Presently, the island is co-managed by both countries. It is a 2,000 sq-meter island. It rises out of the waters of Lake Victoria.

Pair 2 is correct: Nagorno-Karabakh is a disputed territory between Armenia and Azerbaijan. It is located in a region known as the South Caucasus. The Soviet Union established the Nagorno-Karabakh Autonomous Oblast in 1923. It is home to a maximum of Armenian population and is located within Azerbaijan. In 1994, Russia brokered a ceasefire known as the Bishkek Protocol, leaving Nagorno-Karabakh de facto independent, with a self-proclaimed government.

Pair 3 is correct: Kuril Island separates the Sea of Okhotsk from the wider Pacific Ocean. The dispute is over the sovereignty of the South Kuril Islands, comprising Etorofu island, Kunashiri island, Shikotan Island and Habomai island. **Japan and Russia claim their territorial ownership of the land.** Presently, as a successor state to the USSR, Russia has occupied the region, but Japan continues to stake its claim on the islands.

Pair 4 is correct: The **Senkaku Islands, controlled by Japan,** are **also claimed by** the People's Republic of **China** (PRC), which refers to them as the Diaoyu Dao, as well as the Republic of China (ROC) in **Taiwan,** which calls them the Diaoyutai Lieyu.

7. Solution: (c)

Exp) Option c is the correct answer.

The **Mariana Trench, Tonga Trench, and Izu–Ogasawara Trench** are located in the **Pacific Ocean**. These trenches are formed due to **subduction zones**, where one tectonic plate is

forced under another, leading to the creation of deep oceanic depressions.

Option 1 is correct: Mariana Trench (deepest in the world) is located in the **western Pacific Ocean**, near the **Mariana Islands**. It contains the **Challenger Deep**, which is the **deepest known point on Earth's seabed, reaching about 10,994 meters (36,070 feet) below sea level.**

Option 2 is correct: Tonga Trench is in the **South Pacific Ocean**, near **Tonga**. It is one of the deepest trenches in the world, reaching depths of about **10,882 meters (35,702 feet).** It is associated with the subduction of the Pacific Plate beneath the Indo-Australian Plate.

Option 3 is incorrect: The Puerto Rico trench is found in the Atlantic Ocean. It is the deepest part of the Atlantic Ocean. Puerto Rico Trench separates the Atlantic Ocean and the Caribbean Sea.

Option 4 is correct: The **Izu–Ogasawara Trench**, also called the **Izu–Bonin Trench**, is located in the western Pacific Ocean, southeast of Japan. It is an extension of the Japan Trench and reaches a depth of **9,780 meters (32,087 feet)**. This trench is notable for housing the **deepest fish ever recorded**, a juvenile snailfish filmed at **8,336 meters (27,373 feet)**. The slightly warmer waters at these depths allow deep-sea organisms to survive in extreme conditions.

8. Solution: (b)

Exp) Option b is the correct answer.

Row 1 is correct: Lake Titicaca:

- **Location:** It is located in **South America**, specifically between **Peru and Bolivia**.
- **Significant feature:** It is the **highest navigable lake in the world** at an altitude of 3,810 meters (12,500 feet) above sea level.

Row 2 is correct: Caspian Sea:

- **Location:** It is located in the **Central Asia** region, nd is bordered by **Kazakhstan, Iran, Turkmenistan, Azerbaijan and Russia,**
- **Significant feature:** It is a saltwater lake and is the **largest lake in the world** by surface area, covering about 143,000 square miles.

Row 3 is incorrect: Lake Baikal:

- **Location: It is situated in Russia (Siberia),** and **not in Eastern Africa.**
- **Significant feature:** Lake Baikal is indeed the **deepest lake in the world**, with a depth of about 1,642 meters (5,387 feet).

The deepest lake in Africa is **Lake Tanganyika** (4823 feet), which is not the deepest in the world but is the second deepest after Lake Baikal.

9. Solution: (b)

Exp) Option b is the correct answer.

A strait is a narrow body of water that connects two larger bodies of water.

Pair 1 is correct. The Strait of Gibraltar connects the Mediterranean Sea with the Atlantic Ocean. The channel is 58 km long and narrows to 13 km in width between Point Marroquí (Spain) and Point Cires (Morocco).

Pair 2 is incorrect. The Strait of Bosphorus connects the Black Sea and Sea of Marmara. It is a natural strait in Istanbul, Turkey and is one of the world's narrowest straits used for international navigation.

Pair 3 is incorrect. The Bab-el-Mandeb Strait connects the Red Sea to the Gulf of Aden. Situated between Djibouti and Yemen, it represents the southern entry point to the Red Sea and holds strategic importance in connecting the Mediterranean Sea to the Indian Ocean.

Pair 4 is correct. The North Channel is a strait linking the Irish Sea and the North Atlantic Ocean and spans a width of about 22 km at its narrowest point. It acts as the northern gateway to the Irish Sea, allowing access to the North Atlantic.

10. Solution: (a)

Exp) Option a is the correct answer.

Pair 1 is incorrect: The Zagros Mountains are a range in southwestern Iran, stretching from the border regions of eastern **Turkey** and northern **Iraq** to the Strait of Hormuz. The highest point in the range is **Mount Dena**. The mountains serve as a **significant natural barrier**, historically marking boundaries between various cultural and political entities. These include early Mesopotamian and Median cultures, the Parthian and Roman empires, and, in more recent times, the Persian and Ottoman empires.

Pair 2 is correct: The Carpathian Mountains are the second longest mountain range in Europe, spanning about 210,000 square kilometers. This region is **shared by seven countries: Czech Republic, Hungary, Poland, Romania, Serbia, Slovak Republic, and Ukraine**. These mountain ranges serve as a **natural divide between Europe's northern and south-western cultures** resulting in a wide cultural variety.

Pair 3 is incorrect: The Ural Mountains form a natural boundary between Europe and Asia, stretching from the Arctic Ocean to the Ural River in Kazakhstan. They primarily run through **Russia**, with a small portion extending into Kazakhstan. There is no direct association between the Ural Mountains and Turkey. Hence, the given pair is incorrectly matched.

Pair 4 is incorrect: Altai Mountains is in Central Asia and extends from the Gobi Desert to the West Siberian Plains. This mountain range passes through **China, Mongolia, Russia, and Kazakhstan.** It has three main subdivisions: the **Altai proper** (formerly called the Soviet Altai) and the **Mongolian and Gobi Altai. Belukha Peak** is its highest point.

11. Solution: (b)

Exp) Option b is the correct answer.

India has voted in favor of a draft resolution in the United Nations General Assembly (UNGA) expressing serious

concern about Israel's failure to withdraw from the Syrian Golan. The Syrian Golan, situated in southwest Syria, was occupied by Israel in 1967.

Syria attempted to reclaim the Golan Heights during the 1973 Middle East war but was unsuccessful despite inflicting considerable losses on Israeli forces. A ceasefire was eventually signed in 1974, with a **UN observer force deployed along the ceasefire line**. In **1981, Israel unilaterally annexed the Golan Heights**, a move not recognized internationally, although it was acknowledged by the US Trump Administration in March 2019.

The Golan Heights shares borders with Lebanon to the north, Syria to the east, Jordan to the south, and Israel to the west.

Important Tips

- The Golan Heights offer Israel a strategic advantage in monitoring Syrian activities, while its topography serves as a natural barrier against potential military incursions from Syria.
- the area serves as a vital water source for the surrounding arid region, with rainwater from its catchment feeding into the Jordan River.
- The fertile land and volcanic soil of the Golan Heights support agriculture, including vineyards, orchards, and livestock farming. Additionally, it hosts Israel's sole ski resort.

12. Solution: (c)

Exp) option c is the correct answer.

All the mentioned lakes - Lake Toba, Lonar Lake, Taal Lake, and Ojos del Salado Lake - have originated as volcanic crater lakes due to past volcanic activity.

A **Crater Lake** is a specific type of lake that forms within a volcanic crater or caldera. It is typically the result of volcanic activity, where either an explosive eruption or a collapse of the volcano's summit creates a depression that later fills with water. These lakes often have steep, rugged shorelines and are known for their deep blue color and clarity. Crater lakes can vary in size and depth, depending on the scale of the volcanic event that created them

Lake Toba: Located in Indonesia, it is the largest volcanic crater lake in the world, and largest lake in Indonesia. Lake Toba is the result of a super volcanic eruption that occurred around 75,000 years ago. The eruption created a massive caldera, which eventually filled with water to form Lake Toba. In 2020, it was recognized as one of UNESCO's Global Geoparks.

Taal Lake: Found in the Philippines, it is country's third largest lake. Taal Lake is within a caldera formed by past volcanic eruptions. Taal Volcano, which is situated on an island within the lake, is one of the most active volcanoes in the Philippines, and its eruptions have contributed to the formation and evolution of the lake.

Ojos del Salado Lake: Located in the Andes Mountains on the Argentina-Chile border. Ojos del Salado is a crater lake formed within the summit crater of the Ojos del Salado volcano, which is the highest volcano in the world. The lake's presence within the volcanic crater is a result of past volcanic activity in the region.

13. Solution: (c)

Exp) Option c is the correct answer.

Volcanoes are natural geological formations **that result from the eruption of magma from beneath the Earth's surface.** These eruptions can create spectacular displays of lava, ash, and gases, **shaping landscapes and influencing climate patterns**. They also cause a **massive loss to life and property.**

Pair 1 is correctly matched: Mount Merapi is located in Indonesia. It is called the 'Fire Mountain' in Indonesia and Java. It is the **most active volcano in Indonesia**. It has recently erupted in 2023 in West Sumatra, where around 11 hikers had died and around a dozen had gone missing. **Mount Merapi is a stratovolcano** composed of layers of hardened lava, ash, and rocks from previous eruptions.

Pair 2 is correctly matched: Mount Mayon is one of the most active volcanoes, located in the **Albania province of the Philippines**. Recently, in 2023, it has started to spew lava and sulphuric gases that prompted authorities to evacuate residents on a massive scale. It is called as the **world's most perfect volcanic cone** because of the **symmetry of its shape**

Pair 3 is correctly matched: Mount Shishaldin is in Alaska's Aleutian Islands (USA). It is a **cone-shaped stratovolcano** and is one of the **most active volcanoes in the Aleutian Arcs** in the Pacific Ring of Fire. A **significant volcanic explosion took place in July 2023**. This was followed by other smaller explosions.

14. Solution: (b)

Exp) Option b is the correct answer.

An isthmus is a narrow strip of land that connects two larger landmasses and separates two bodies of water.

Pair 1 is correct: The **Isthmus of Kra**, which acts as a land bridge that connects the Malay Peninsula with the rest of continental Southeast Asia. The isthmus lies between the Gulf of Thailand to the east and the Andaman Sea to the west. **Thailand is planning to build a 90 km long bridge (road and rail links) in the Kra Isthmus.**

Pair 2 is correct: The **Isthmus of Panama** links the **continents of North and South America and** separates the Pacific and Atlantic Oceans. Recently, traffic through the canal has slowed down due to a prolonged drought that has diminished the amount of available water used to fill the canal locks.

Pair 3 is incorrect: In eastern Egypt, **the Isthmus of Suez serves as a link between the continents of Africa and Asia (not Europe)** while dividing the Mediterranean and Red Seas. A significant incident occurred recently when a large cargo ship named 'Ever Given' stuck near the southern terminus of the Suez Canal. This event has resulted in a substantial backlog of vessels accumulating at both entrances of this crucial international trade route.

Pair 4 is incorrect: The **Isthmus of Tehuantepec connects the landmasses of North America and South America** and separates the Gulf of Mexico from the Pacific Ocean. The Interoceanic Corridor (CIIT) project is aimed at providing a rail link between the Atlantic and Pacific oceans, is expected to commission soon.

The **Isthmus of Corinth** is the narrow land bridge which **connects the Peloponnese peninsula with the rest of the mainland of Greece**, near the city of Corinth.

15. Solution: (c)

Exp) Option c is the correct answer.

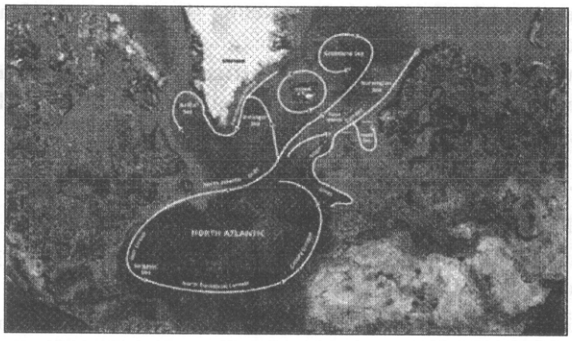
Recently, Philippine coastguard has dismantled a floating barrier placed by China in a contested region of the South China Sea. According to the Philippines, the barrier posed a navigation hazard and a clear violation of international law.

Option 1 is incorrect: Laos is a landlocked country meaning it does not share any borders with the Sea. Hence Laos does not share boundary with South China Sea.

Options 2,3,4 and 5 are correct: The South China Sea is bordered by the People's Republic of China; the Republic of China **(Taiwan);** the Socialist Republic of **Vietnam**; the Republic of the **Philippines**; **Malaysia**; the Sultanate of **Brunei** Darussalam; and the Republic of **Indonesia**.

16. Solution: (d)

Exp) Option d is the correct answer.



The **"Big Trunk Route"** is often used as a synonym for the **North Atlantic Sea Route**, which is the **busiest sea route in the world**. It connects **Western Europe and North America.**

17. Solution: (b)

Exp) Option b is the correct answer.

Pair 1 is incorrect: Sela Tunnel

1. It is located **in Arunachal Pradesh, not Sikkim.**
2. It was **inaugurated in March 2024**, by Prime Minister Narendra Modi.
3. Being constructed at **Sela Pass**, it will ensure **all-weather connectivity to Tawang** and forward areas along the India-China border.
4. It is being built by the **Border Roads Organisation** (BRO) under **Project Vartak**.
5. The tunnel is being built at an altitude of **13,000 feet**, making **it one of the world's highest bi-lane tunnels.** Once completed, it will significantly improve military logistics and boost tourism in Arunachal Pradesh.

Pair 2 is incorrect: Shinku La Tunnel

1. It is located on the **Himachal Pradesh-Ladakh border, not Uttarakhand.**
2. This is a strategic tunnel being built at **Shinku La Pass** to provide **year-round connectivity to Ladakh's Zanskar Valley.**
3. It is part of the Nimu-Padam-Darcha Road, which is an alternative route to Ladakh, bypassing the high-altitude passes of the Manali-Leh Highway.
4. Once completed, it will be **India's highest tunnel**, situated at around **16,500 feet.**

Pair 3 is correct: Sonamarg Tunnel

1. The Sonamarg Tunnel, also known as **the Z-Morh Tunnel**, is a vital **6.5 km-long** tunnel in the **Ganderbal district of Jammu and Kashmir**.
2. It was inaugurated **in January 2025**, by Prime Minister Narendra Modi.
3. It connects **Gagangir and Sonamarg** and is situated at an altitude of over **8,500 feet**.
4. It will ensure **all-weather connectivity between Srinagar and Sonamarg**, bypassing avalanche-prone areas and reducing travel time by about an hour.

Pair 4 is correct: Atal Tunnel

1. It is located in **Himachal Pradesh.**
2. The Atal Tunnel (**Rohtang Tunnel**), named after former PM Atal Bihari Vajpayee, and was inaugurated on October 3, 2020, by Prime Minister Narendra Modi.
3. It is a highway tunnel built under **Rohtang pass** in the eastern **Pir Panjal range** of the Himalayas.
4. It provides all-weather connectivity between **Manali and Lahaul-Spiti**.
5. It is **9.02 km long**, making it the **world's longest highway tunnel above 10,000 feet.**
6. It is a crucial infrastructure project for both civilian transport and military logistics in border areas.

7.2. Miscellaneous

18. Solution: (b)

Exp) Option b is the correct answer.

In shifting agriculture, after two or three years of producing vegetable and grain crops on cleared land, the migrants abandon it for another plot. Land is often cleared by slash-and-burn methods—trees, bushes and forests are cleared by slashing, and the remaining vegetation is burnt. The ashes add potash to the soil. Then the seeds are sown after the rains. In different regions it is known by different local names.

Pair 1 is correct. Deepa Shifting Cultivation –This shifting cultivation is practiced in Bastar district of Chhattisgarh and locally known as Deepa.

Pair 2 is correct. Kumari Shifting Cultivation- This cultivation is practiced in Western Ghats especially in hilly regions of Kerala. Western Ghats are mountain ranges that runs parallel to western coast of India.

Pair 3 is incorrect. Valre or waltre Shifting Cultivation- This shifting cultivation is practiced in Southeastern Rajasthan and not in Jharkhand. Hence this statement is incorrect.

19. Solution: (d)

Exp) Option d is the correct answer.

The basic principle behind Kolkhoz model of farming is based on social ownership of the means of production and collective labour. Collective farming or the model of Kolkhoz was introduced in erstwhile Soviet Union to improve upon the inefficiency of the previous methods of agriculture and to boost agricultural production for self-sufficiency. In this model, the farmers used to pool in all their resources like land, livestock and labour. However, they were allowed to retain very small plots to grow crops in order to meet their daily requirements.

20. Solution: (a)

Exp) Option a is the correct answer

Cropping intensity refers to the number of crops grown on a piece of land during a certain period of time, usually a year. **By growing more crops in the same area during a specific time period, the intensity of cropping increases.** This can be achieved through multiple cropping systems or intercropping, where different crops are grown together or sequentially in the same field. It maximizes land use and increases productivity.

21. Solution: (b)

Exp) Option b is the correct answer.

Pair 1 is correct. The Grey revolution in India was started in the 1960s to 1970s. This revolution **aimed to increase fertilizer production**. The Grey revolution **focused on increasing the use of fertilizer** to boost the growth of higher-yielding seeds. Also, there were certain drawbacks in the green revolution which were rectified with the help of grey revolution.

Pair 2 is correct. The period between 1991 to 2003 is known as the period of Golden Revolution in India. The Golden revolution is related to the **production of honey and horticulture**. It is a part of the important agricultural revolutions of India.

Pair 3 is incorrect. The Silver Revolution is related to egg and poultry **production. It was started in 1969-1978** and medical sciences and innovation played an important role in this revolution. The scientists led the spectacular Silver Revolution by the hybrid of cocks and hens which resulted in increases in poultry production. Hence this statement is incorrect.

22. Solution: (a)

Exp) Option a is the correct answer.

Hydrological cycle is the continuous process by which water is transported from the oceans to the atmosphere and then onto the land and back to the sea. It is a global process linking up seas, lakes, streams, groundwater, soil moisture and atmospheric vapour into a single whole.

Statement 1 is correct and 2 is incorrect: The hydrological cycle in its atmospheric, land and oceanic phases undergoes various processes like evaporation, precipitation, interception, transpiration, infiltration, percolation, storage and runoff. **The total volume of water in the global hydrological cycle remains essentially constant, while the distribution of this water is continually changing on continents, within regions, and within local drainage basins.**

23. Solution: (a)

Exp) Option a is the correct answer

There are six major kinds of islands: (1) continental Island, (2) Tidal Island, (3) Barrier Island, (4) oceanic Island, (5) coral island, and (6) artificial.

Pair 1 is incorrect, and **Pair 2 is correct.** Continental islands may be formed as a **result of breakup from the continent.** For instance, Pangaea (A supercontinent) was the single continent millions of years ago. It was split into several smaller continents due to slow movement of the earth. Some fragments of land from these continents became islands. For example, **Madagascar Island** and **Greenland Island** are the **continental islands** formed because of **drifting of the continents**.

Pair 3 is incorrect. British Isles are not a tidal island but a Continental Island. Changes in sea level also result in formation of the Continental islands. During inter-glacial period, glaciers melt, and sea level rise leads to submergence of part of the continent. For example, during the ongoing inter-glacial period, due to same phenomenon ocean flooded many low-lying areas and created islands. For instance, **the British Isles**, which were once part of mainland Europe were created in this way.

On the other hand, a tidal island is a piece of land that is connected to the mainland at low tide at which time they can be reached on foot. At high tide however it is completely cut off from the mainland and becomes a real island.

24. Solution: (a)

Exp) Option a is the correct answer.

Statement 1 is incorrect: The **rising sea temperatures favorably contribute to the growth of jellyfish populations.** Increased sightings of jellyfish signal the rise in sea temperatures due to climate change. Jellyfish populations tend to thrive in warmer waters.

Statement 2 is incorrect: The yields of olives are adversely affected due to global warming. Global warming induced by rising temperatures has caused droughts, floods, and forest fires, which is detrimental to olive cultivation. This also is evident from the fact that due to these reasons; the global output of olive oil has fallen from 3.67 million tonnes to 2.5 million tonnes during the current year.

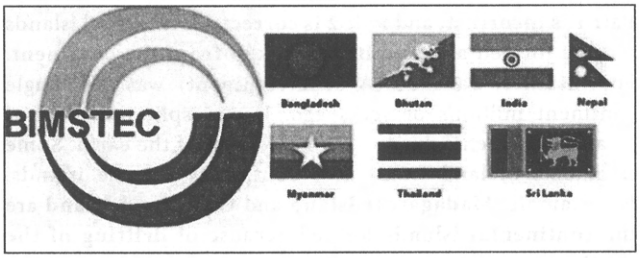
Statement 3 is correct: The Bramble Cay melomys, or Bramble Cay mosaic-tailed rat, is a recently extinct species of rodent. **The Bramble Cay melomys (Melomys rubicola) is the first mammal reported to have gone extinct as a direct result of climate change.** Previously found only on the island of Bramble Cay in Great Barrier Reef, its habitat was destroyed by rising sea levels. Over 90% of the vegetation of the cay has been lost since 2004 due to sea water inundation. This reduction in food and cover would have undoubtedly contributed to its extinction. Hence, the given statement is correct.

25. Solution: (c)

Exp) Option c is the correct answer.

BIMSTEC (Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation) is a regional organization, established in **1997** with the **Bangkok Declaration.** It aims to promote technical and economic cooperation among countries in the Bay of Bengal region.

It has **seven member countries:**



1. **Bangladesh**
2. **Bhutan**
3. **India**
4. **Nepal**
5. **Myanmar**
6. **Thailand**
7. **Sri Lanka**

Important Tips

BIMSTEC Charter

1. It is the fundamental document that outlines the organization's objectives, principles, and structural framework.
2. It was formally adopted in March 2022 during the 5th BIMSTEC Summit.

26. Solution: (b)

Exp) Option b is the correct answer.

Mixed farming involves moderate-sized farms cultivating crops such as **wheat, barley, oats, rye, maize, fodder, and root crops.** Fodder crops hold significance, and the practice emphasizes both **crop cultivation and animal husbandry,** with livestock including **cattle, sheep, pigs, and poultry. Crop rotation and intercropping** are vital for maintaining soil fertility in this agricultural approach.

Statement 1 is incorrect- Mixed farming does not involve monoculture i.e., growing only one type of crop at a time. It involves growing **multiple crops alongside raising livestock.**

Statement 2 is correct- In mixed farming, emphasis is laid on **crop cultivation and animal husbandry.** Animals like **cattle, sheep, pigs and poultry** provide the main income along with crops.

Statement 3 is correct- Mixed farming is prevalent in highly developed regions like **Northwestern Europe, Eastern North America, parts of Eurasia, and temperate zones in Southern continents.** However, the two largest regions for mixed farming are **Eurasia and the United States.**

27. Solution: (c)

Exp) Option c is the correct answer.

Road Transport is a critical infrastructure for the economic development of a country. India has the second largest road network in the world with **about 66.71 lakh km of road length.** This comprises National Highways, Expressways, State Highways, District Roads, District Roads and Village Roads.

Option 1: Presently, **National Highways** have a total length of **1,46,145 km**

Option 2: Presently, **State Highways** have a total length of **1,79,535 km**

Option 3: As per the most latest data available of 2019, **District Roads** have a total length of **more than 6 lakh km**

Option 4: As per the most latest data available of 2019, **Village Roads** have a total length of **more than 45 lakhs km**

28. Solution: (c)

Exp) Option c is the correct answer.

Statement 1 is correct: North-South Corridor (NSC) under Golden Quadrilateral Project

1. **Route: Srinagar (Jammu & Kashmir) to Kanyakumari (Tamil Nadu)**, including a spur to Kochi (Kerala)
2. **Total Length:** 4,076 km
3. **States Covered:** Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Delhi, Uttar Pradesh, Madhya Pradesh, Maharashtra, Telangana, Andhra Pradesh, Karnataka, Tamil Nadu, Kerala
4. **Objective:** To improve road connectivity between the northernmost and southernmost parts of India, boosting trade and regional integration.

Statement 2 is correct: East-West Corridor (EWC) under Golden Quadrilateral Project

1. **Route: Silchar (Assam) to Porbandar (Gujarat)**
2. **Total Length:** 3,640 km
3. **States Covered:** Assam, West Bengal, Bihar, Uttar Pradesh, Madhya Pradesh, Rajasthan, Gujarat
4. **Objective:** To provide seamless connectivity across the eastern and western regions of India, integrating remote areas with the economic hubs of the country.

29. Solution: (d)

Exp) Option d is the correct answer.

The **Border Roads Organisation** (BRO) was established in **1960** to develop and maintain road infrastructure in border areas and strategically important regions. It plays a crucial role in enhancing connectivity, ensuring troop mobility, and supporting socio-economic development in remote border areas.

Statement 1 is incorrect: The **Vibrant Villages Programme** (VVP) was approved by the Government of India as a Centrally Sponsored Scheme in February 2023.

- It aims to develop infrastructure and ensure livelihood opportunities in border villages along the northern border of India, particularly in Arunachal Pradesh, Sikkim, Uttarakhand, Himachal Pradesh, and Ladakh.
- The **Union Ministry of Home Affairs** (MHA) is the **nodal ministry for the implementation of this scheme, not the BRO,** which falls under the Ministry of Defence.

Statement 2 is incorrect: The BRO was originally established under the Ministry of Road Transport and Highways (MoRTH) in 1960 to construct and maintain roads in border areas. However, in **2015, its administrative control was transferred to the Ministry of Defence** (MoD) to ensure better coordination for strategic infrastructure development in border regions. Hence **BRO now operates under MoD, not MoRTH.**

30. Solution: (c)

Exp) Option c is the correct answer.

Service Sector refers to the tertiary sector of the economy which focuses on providing various types of services. Trade, transport, communication, education, health, insurance, banking, consultation are some of the activities of the service sector.

Option 1 is correct. Research and Development (R&D) is generally considered to fall under the service sector, specifically within the "quaternary sector".

Option 2 is correct. Transportation is a Service Sector activity. It includes the transportation through rails, roads, air and water.

Option 3 is correct. Real Estate is an activity of the service sector. The real estate sector comprises four sub-sectors - housing, retail, hospitality, and commercial.

31. Solution: (d)

Exp) Option d is the correct answer.

Statement 1 is correct: Mediterranean agriculture is highly specialised commercial agriculture. It is practised in the countries on either side of the Mediterranean sea in Europe and in north Africa from Tunisia to Atlantic coast, **southern California, central Chile, south western parts of South Africa and south and south western parts of Australia.** This region is an important supplier of citrus fruits.

Statement 2 is correct: Factors like the length of summer drought, water availability for irrigation and power supply, local soil conditions, financial aspects, and fluctuations in the local, regional, and global markets govern Mediterranean agriculture.

These conditions lead to four types of agriculture in this region as under:

1) **Orchard farming: Citrus fruits, olives, and figs.**
2) **Viticulture: Grapes for wine-making.**
3) Cereal and vegetable cultivation: Wheat (hard winter type), barley, rice in river plains, green and leafy vegetables, lentils, beans, onions, tomatoes, carrots, and sugarbeet.
4) Limited animal husbandry: goats, sheep, dairy farming, and fishing.

Statement 3 is correct: The Mediterranean climate supports a variety of field crops, with cereals being the most important. **Wheat is the primary food crop, though its cultivation is not as ideal as in cooler temperate regions.** Mediterranean farmers have adapted to the seasonal climate by making the most of its rhythms. The wheat grown is mainly hard winter wheat, which is well-suited for producing bread and other food products such as macaroni, spaghetti, and vermicelli.

32. Solution: (b)

Exp) Option b is the correct answer.

Primitive subsistence agriculture, also known as shifting cultivation, is commonly practiced by many tribes in tropical regions, particularly in Africa, South and Central America, and Southeast Asia. In this practice, vegetation is cleared through fire, and the resulting ashes enrich the soil, enhancing its fertility. Due to this method, it is also referred to as slash-and-burn agriculture. This form of agriculture is known by different names across various tropical regions of the world.

Option 1 is incorrect: The term **Milpa** refers to a form of shifting cultivation practiced in **Central America, Mexico and in Africa (not in Indonesia). In Indonesia,** the shifting cultivation is known as **Humah.**

Option 2 is correct: Ladang refers to shifting cultivation in **Malaysia**, typically involving the clearing of forest land for cultivation.

Option 3 is correct: Chena is a form of shifting cultivation practiced in **Sri Lanka**, where land is cleared for agriculture.

Option 4 is incorrect: In India, shifting cultivation is known by various names depending on the region. For example, it is called podu by the Kui-speaking Kondhs of Orissa and Andhra Pradesh, jhum by tribes in the Northeastern states, and Kothu Kadu or Kumri among tribes in **Southern India.** In **Venezuela, the shifting cultivation is known as Conuco.**

33. Solution: (c)

Exp) Option c is the correct answer.

Zero-budget natural farming is a holistic agroecological alternative based on modern and traditional science that mitigates the consequences of climate change, reduces input costs and creates sustainable agricultural livelihoods.

Farmers use four treatments to enhance productivity at low cost:

...mrita (Seed treatments using local cow dung and ...rine);

Jiwamrita (soil inoculant made of cow dung and urine);

- Mulching (ensure favourable microclimate soil); and
- **Waaphasa (soil aeration).**

These treatments are chemical-free agriculture at the lowest/ zero-cost and enhance the incomes of farmers.

Thus, "Four wheels of ZBNF"are Bijamrit, Jivamrit, Mulching and Waaphasa.

Bijamrit is the microbial coating of seeds with formulations of cow urine and cow dung.

Jivamrit is the enhancement of soil microbes using an inoculum of cow dung, cow urine, and jaggery. Mulching is the covering of soil with crops or crop residues.

Waaphasa is the building up of soil humus to increase soil aeration.

In addition, ZBNF includes three methods of insect and pest management: Agniastra, Brahmastra and Neemastra (all different preparations using cow urine, cow dung, tobacco, fruits, green chilli, garlic and neem).

34. Solution: (c)

Exp) Option c is the correct answer..

The distribution of water on the Earth's surface is extremely uneven.

Only 3% of water on the surface is fresh; the remaining 97% resides in the ocean. Of freshwater, 69% resides in glaciers, **30% exists as groundwater,** and less than 1% is located in lakes, rivers, and swamps.

35. Solution: (b)

Exp) Option b is the correct answer.

Antarctica is the world's largest ice sheet. Much of the Antarctic ice sheet surface lies above 3000 m above sea level. This massive thickness of ice drowns whole mountain ranges, and numerous volcanoes exist underneath the icey exterior.

Statement 1 is correct. The Antarctic Ice Sheet is drained by fast-flowing ice streams, which respond quickly to climate change; they can thin, accelerate, recede, or even stop flowing entirely. Beneath the thick skin of ice, there is flowing water and subglacial lakes.

Antarctic **glaciers terminate on land or in the sea, as floating ice shelves or grounded or floating outlet glaciers.**

Statement 2 is incorrect. Antarctica is affected by ocean currents. Parts of West Antarctica are grounded well below sea level, which can act to destablise the ice sheet. **Warm ocean currents are able to melt ice shelves from below, and cause a retreat of** the glaciers. The Antarctic Circumpolar Current (ACC) is an ocean current that flows clockwise from west to east around Antarctica.

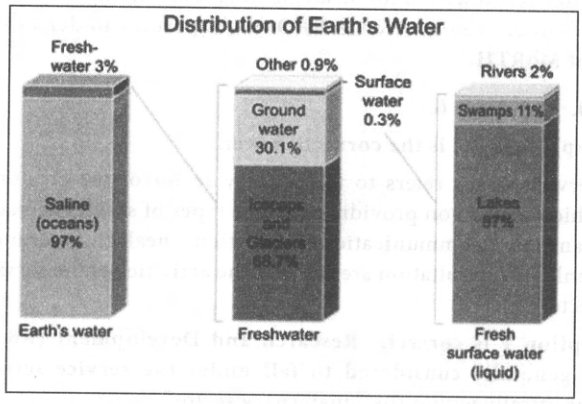
Statement 3 is correct. Warming over the Antarctic Peninsula is exacerbated by a strengthening of the Antarctic Oscillation, which is a periodic strengthening and **weakening of the tropospheric westerlies that surround Antarctica.** Changing pressure patterns result in flow anomalies, with cooling over East Antarctica and **warming over the Antarctic Peninsula.**

Relevance: A huge ice block has broken off from western Antarctica into the Weddell Sea, becoming the largest iceberg in the world and earning the name A-76.

36. Solution: (b)

Exp) Option b is the correct answer..

Statement 1 is incorrect. Of the total freshwater, 69% resides in glaciers, **30% underground, and less than 1% is located in lakes, rivers, and swamps.** Thus, the amount of water in rivers and lakes is **less** than amount of groundwater.



Statement 2 is correct: About **2.1% of all of Earth's water is frozen in glaciers.** About three-quarters of Earth's freshwater is stored in glaciers. Therefore, **glacier ice is the second largest reservoir of water on Earth** and the **largest reservoir of freshwater on Earth.**

- 97.2% is in the oceans and inland seas
- 2.1% is in glaciers
- 0.6% is in groundwater and soil moisture
- less than 1% is in the atmosphere
- less than 1% is in lakes and rivers
- less than 1% is in all living plants and animals.